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Urinary Diagnosis and Treatment.

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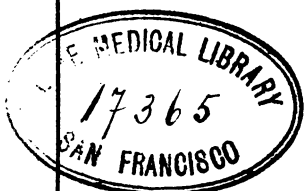
By JOHN W. WAINWRIGHT, M. D.,

MEMBER OF THE AMERICAN MEDICAL ASSOCIATION; OF THE NEWYORK STATE MEDICAL ASSOCIATION; OF THE NEW YORK COUNTY MEDICAL ASSOCIATION, ETC.



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PREFACE.

If an apology for increasing the already voluminous literature on urinary analysis and diagnosis be due the reader, it will be because there is at the present time no work which embodies the simplest methods of chemical and microscopical examinations with the latest deductions and theories concerning the general routine treatment of the conditions found.

The busy general practitioner, whose time will not permit of extensive study or reference to the various authorities on this subject, and whose somewhat limited knowledge of chemistry and microscopical technique becomes more or less confused by the great number and intricacies of the innumerable methods given in the text-books, is often discouraged at the problem before him.

As the clinical examination of urine is of such positive necessity to the proper and intelligent understanding and definite treatment of the various conditions found, and as the meth-

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ods necessary to arrive at a positive diagnosis can be simplified to such an extent that hardly any chemical knowledge is really necessary, it will be my effort in the following pages not only to give the easiest methods of examination, but also to elucidate the latest theories, as well as to point out the up-to-date treatment required in each condition.

J. W. W.

NEW YORK, December 1st, 1900.

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CHAPTER I.

INTRODUCTION.

The urine represents principally the products of metabolism. Its constituents are not formed in the kidneys, these organs only acting as the means of eliminating from the organism the waste products of the economy.

The carbohydrates and hydrocarbons, represented in the form of starches, sugars and fats of our food, go to supply the fuel of our bodies and are gradually oxidized or "burned up" by the lungs and liver without, under normal conditions and when partaken of to the normal extent, ever reaching the kidneys.

The nitrogenous foods or albumins are by the digestive organs transformed into albumoses and peptones, which, after absorption, are reconverted into albumins and go to replenish the waste in protoplasm of the various cells. The waste products, representing the retrogressive metamorphosis of the animal or-

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ganism, are absorbed by the blood, and eliminated by the kidneys in the form of nitrogenous constituents in the urine. Whenever, therefore, metabolism is at fault, whenever from some cause pathological changes have taken place in the kidneys themselves, thereby interfering with their proper functions, we aim to establish the sequences by a proper examination of the urine, and thus by early recognition of all the existing troubles, we may succeed in our aim to bring the desired cure, or at least amelioration, by appropriate treatment or regime.

As we shall meet with better success in our efforts to stop further damage the earlier we recognize the existing trouble, it is of the utmost importance that our examination of the urine be carefully and early made, and with the best and most modern appliances. It is easy enough to diagnose phthisis in its advanced stages and when beyond cure. This is true also of severe diabetes or nephritis. It is the incipient forms of pulmonary disease, as well as of kidney affections, that take the most careful examinations; and thus we have as a reward for our investigations the satisfaction

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of an early diagnosis, while there is yet time for our treatment to bring relief or cure.

To understand and appreciate fully the difference between a pathological and a physiological condition which in one way or another show their effects in the urine, we will undertake a short resumé of these conditions before attempting to classify and make clear the various methods of urinary examinations.

The normal urine represents, as we know, the soluble nitrogenous waste products of animal life which, together with inorganic and organic salts, are kept in solution by a varying amount of water. Whenever the tissue waste is abnormally increased, as in excessive physical exercise, the percentage of nitrogenous matter is correspondingly increased in the urine, while the percentage of phosphates is higher after severe mental effort or strain. The truth of these assertions is easily proven by the determination of the amount of urea found in the urine of an athlete after a severe effort, or the amount of phosphate voided by a student at the time of examination.

Under abnormal and still physiological con-

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ditions, the urine assumes temporary peculiarities which, if continued, shows that the conditions have gradually changed from physiological to pathological, causing more or less damage, which no treatment will undo, even if the conditions will temporarily improve under appropriate regimen. As an example of this we may quote the gourmand, who frequently indulges to an excessive extent in sugars and starchy foods, perhaps to almost total exclusion of nitrogenous foods. We shall find that the urine of such a person after this unreasonable indulgence will contain glucose. Experience has also proven that it is just this class of people who suffer from glycosuria, and it is therefore but logical to conclude that the first thing to be considered in the treatment of such a case is to entirely exclude carbohydrates from the dietary, thereby giving the overworked liver a well needed rest.

What was at first a physiological condition has in such a case become pathological, and even though the glycosuria disappears and the general condition of the patient is considerably improved by appropriate diet and treatment,

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still we may expect recurrence of the symptoms whenever the least indiscretion in the dietary is indulged.

Another example may not be out of place. Many substances act as especial irritants upon the kidneys. Among these are certain drugs such as turpentine, cantharides, etc., also alcohol and the toxins formed by the blood in infectious diseases. Professor Atwater has proven that a certain small amount of alcohol can be partaken of without ever reaching the kidneys, as it is oxidized in the lungs. Anything above this amount must, however, be eliminated from the system by the kidneys, causing more or less irritation according to the quantity partaken of, as well as the susceptibility of the individual. In pyrexia and probably also in cases of poisoning from venomous snakes, where the process of oxidation is especially active, large amounts of alcohol can be taken without ever reaching the kidneys. In these cases it supplies the fuel that otherwise would have to be taken from the body tissues exclusively. The experience of arctic explorers, on the contrary, has proven that even small

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amounts of alcoholic beverages are undesirable under conditions of persistently low temperatures.

The toxins of infectious diseases, such as diphtheria, scarlatina, erysipelas, etc., being so-called tox-albumins probably, take no part in the process of pulmonary oxidation, and are eliminated from the body through the kidneys. As the irritating effect of these toxins, as well as of alcohol, is more pronounced the more concentrated they reach the kidneys, we can well see the philosophy of the recommendation to give such individuals a liberal amount of water, diuretics and liquid nourishment. Notwithstanding such precautions, we shall as a rule find the presence of albumin in the urine of patients suffering from most infectious diseases, and if we do not "flush the kidneys" with large amounts of liquids we often find post-scarlatinal and other nephrites as a sequence, especially in individuals susceptible to nephritic troubles.

In chronic alcoholics, who daily exceed the amount of alcohol that in each individual case can be taken with impunity, there is a continual

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irritation to the renal epithelium with a coincident "low" inflammation. As a result there is, as in all chronic inflammations, a hyperplasia or formation of new tissue which causes gradual cicatricial contraction of the surrounding tissues, and partial atrophy of the epithelium—in other words, chronic interstitial nephritis.

In such conditions the amount of albumin is always very small, therefore we have to exercise especial care in making the chemical examinations; it is only by careful search of the urinary sediment with the microscope that we can confirm our suspicions, as we are always certain to find casts, — hyalin, epithelial or granular in character. In such interstitial troubles the new-formed scar tissues gradually compress the different renal arterioles; the general arterial circulation of the kidneys is impaired causing further atrophic damage, besides damming the blood back into the liver, stomach, etc., whereby at first hypertrophic, then atrophic changes are wrought in these organs. The great importance of an early

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recognition of these conditions can consequently easily be seen.

We must, however, bear in mind, that traces of albumin may be found under many other conditions. In intestinal obstructions, persistent constipation, etc., where the excretion of the toxins formed by microbic or fermentative changes is prevented, they are absorbed by the blood and finally eliminated by the kidneys, and thus a more or less acute irritative inflammation with its coincident albuminuria is caused. Temporary albuminuria may also follow cold bathing, muscular exertion, nervous shock, the taking of an anesthetic, and many other conditions. Whenever there is pus or blood in the urine, no matter from what cause, we will always find albumin, as leucocytes, pus and blood-cells are albuminous bodies.

In certain forms of interstitial nephritis, it is sometimes very hard to demonstrate the presence of albumin. This is especially the case with the morning urine, which in other instances holds the greatest percentage of albumin. Whenever, therefore, we have cause to suspect nephritis, without being able to demon-

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strate either albumin or casts, the best procedure is either to obtain the total amount of the urine for twenty-four consecutive hours, or else to examine separate specimens, voided at different times during the day, as for instance, morning, evening and after meals.

As many errors may otherwise occur, we must always make it a routine practice to filter every specimen of urine before applying any test, be it for albumin or anything else. In cases of cystitis, where bacteria abound, it will sometimes be necessary to add a few drops of caustic soda or some calcined magnesia when the precipitated phosphates will carry with them the bacteria and we get a clear filtrate, which will enable us to better observe small traces of albumin. The demonstration of albumin in the urine is, however, *per se* of far less importance than formerly supposed. Even if repeated examinations show traces of albumin and some few hyaline or granular casts, there may be no immediate danger so long as the amount of urea excreted in the twenty-four hours comes up to a fair average. Whenever the urea is considerably diminished, however,

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we have far more to fear, even though we get but a slight trace of albumin, as this clearly points to impaired renal function, or in other words, shows that the products of tissue change, instead of being excreted by the kidneys, remain in the blood causing a sort of toxemia or intoxication from which serious or fatal issue may at any time result. With a continued, small, daily excretion of urea we are very apt to find fatty as well as granular casts, proving that the epithelium of the convoluted tubes (the functional excretory apparatus of the kidney while the glomeruli are the water filters, so to speak, that wash out the excretory matter) is impaired by more or less general fatty, destructive degeneration. The prognosis under these conditions must always be most grave.

A high percentage of albumin with numerous hyalin, some blood and granular casts, indicates an acute, parenchymatous nephritis, which is not necessarily serious, especially if the amount of urea is fair.

It is easily seen, therefore, that the usual chemical tests for albumin are in themselves

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not of such positive importance as formerly taught. The microscopical examination of the urinary sediments are really of more diagnostic value, as the number and kind of casts, etc., prove the pathological condition before us far more clearly than does the percentage of albumin.

We have seen that the total amount of urea excreted through the kidneys during each twenty-four hours is a most important indication of their conditon. As the quantitative tests described in the following pages are so simple that but a few carefully-made examinations will perfect even a beginner in the technique, it is to be hoped that the aim of my work to popularize urinary diagnosis among general practitioners will be attained.

Much has of late years been said and done regarding oxaluria, or the continued presence of crystals of calcium oxalate in the urine. Whether oxaluria is the cause of the nervous, mental and physical conditions of the patients thus affected, or only the effect, is not positively demonstrated. It seems, however, probable that oxaluria is the palpable effect of some

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faulty metabolism, as yet undefined, though digestive disturbances may be the causative agents. The presence, to any unusual extent, of uric acid (or, rather of urates, as the free acid is never present in the urine) indicates faulty oxidation; urea represents complete oxidation, uric acid but a transitory or incomplete state of oxidation. We shall find an increase of urates in diseases of the heart and blood when the process of oxidation is impaired, as well as in excessive meat-eaters, where the ingestion of nitrogenous foods is too great for their proper absorption and normal metabolism.

The presence in the urine of peptone, albumose, bile, leucin and tyrosin, etc., will be considered under their proper headings.

Many an applicant for life insurance has been rejected on account of the *accidental* presence in the urine of a more or less pronounced trace of sugar or albumin. The injustice of this is easily seen, and the careful and painstaking examiner of a rival insurance company will in such cases be the one to discover the mistake. The same blunder is also often made

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in private practice, when (after finding a trace of sugar or albumin in the urine of a patient with ill-defined and numerous complaints) the careless practitioner, to the great discomfort and worry of both the patient and his family, gravely announces his discovery and gives a most discouraging prognosis. A careful and repeated examination of the urine is therefore indicated in all instances and great care should be taken that the patient is not unnecessarily alarmed or even informed of the condition until a diagnosis can be positively made.

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CHAPTER II.

COMPOSITION AND PHYSICAL PROPERTIES OF URINE.

COMPOSITION OF URINE.

The average composition of human urine is, according to Simon:

Water	95.76	per	cent
Urea	2.50	"	"
Uric Acid	0.04	"	"
Hippuric Acid, Creatin, Creatinine, Coloring Matter, Mucus	0.40	"	"
Organic Matter, Phosphates of Sodium, Potassium, Chlorides, Calcium, Sulphates, Magnesium, Iron	1.30	"	"

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Or excreted in 24 hours.

	Grams.	Per Cent.
Total Solids	60 —70	4.3 —4.6
Urea	30 —40	2.5 —3.2
Uric Acid	0.4— 0.8	0.03 —0.05
Creatinine	0.5— 1.0	0.036—0.062
Hippuric Acid	0.3— 1.0	0.02 —0.06
Chlorides	10 —13	0.7 —0.8
Earthy Phosphates	0.9— 1.3	0.07 —0.08
Phosphoric Acid	2.5— 3.5	0.19 —0.22
Sulphuric Acid	1.5— 2.5	0.16 —0.17

SEDIMENT IN URINE.

Using the classification of modern investigators we have a sediment from acid urine which differs from that of alkaline urine.

"A," Not Organized.

a. Amorphous.

Acid Urine.	*Alkaline Urine.*
1. Urates of sodium and potassium,	1. Calcium phosphate,
2. Fat.	2. Calcium carbonate.

b. Crystalline.

1. Uric acid,	1. Ammonium urate,
2. Calcium oxalate,	2. Triple phosphate,

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b. Crystalline—*Continued.*

3. Cystin,
4. Tyrosin.
3. Calcium phosphate,
4. Magnesium phosphate.

"B," Organized.

1. Mucus and pus corpuscles,
2. Blood corpuscles,
3. Epithelium,
4. Tube casts,
5. Spermatozoa,
6. Bacteria,
7. Fungi.

DETERMINATION OF SOLIDS IN URINE.

Take the last two figures of the specific gravity and multiply by 2.33. The result will correspond to the amount of solids in 1000 c. c. of urine expressed in grams. For instance, if the patient shall pass 1450 c. c. of urine during the twenty-four hours which will have a specific gravity of 1,018, the total solids in 1000 c. c. will be 18x2.33=41.94 grams, while for 1450 c. c. we will have 60.81 grams. A more accurate method will be to evaporate the total quantity of urine voided for twenty-four hours over a water bath until all the water shall have been driven off, and weighing the amount of solids thus secured.

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The amount of solids contained in normal urine for 24 hours will vary between 60 and 70 grams; should there be 200 grams we will suspect diabetes. If less than the normal amount, say 20 grams, and the quantity of fluid not diminished we will have hydruria. If there exist a diseased kidney, the amount of urine excreted, whether normal or diminished, if with a very low specific gravity will point to uremia, inasmuch as the usual amount of urea is not excreted (urea constituting nearly half the solids excreted). The character and amount of the food taken will influence the amount of solids excreted, and when there has been fasting, as in fevers, the amount will average 30 grams. In pneumonia under a strict diet 40 grams of solids will be regarded as an increase.

QUANTITY OF URINE EXCRETED.

The quantity of urine excreted normally during the 24 hours is forty to fifty ounces, or 1500 c. cm.

This quantity increases:

a. after copious ingestion of fluids.

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b. in cold weather (diminished perspiration).
c. in certain neurasthenic conditions and anemia.
d. in hydruria (diabetes insipidus).
e. in diabetes mellitus.
f. after the administration of diuretics.
g. in chronic Bright's disease of the atrophic variety.

This quantity decreases:

a. when little fluid is taken.
b. in hot weather (profuse perspiration).
c. in pyretic conditions.
d. in acute nephritis.
e. In conditions accompanied by weak heart action.
f. after the administration of certain drugs, as opium and its alkaloids, for instance.

The urine is suppressed:

a. in acute Bright's disease.
b. in shock.
c. in excessive diarrhea.
d. in obstruction of urinary passages.

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SPECIFIC GRAVITY OF URINE.

The specific gravity is normally between 1.015 and 1.025, varying according to quantities of constituents in solution.

High specific gravity is found in:

a. Concentrated urine.
b. After the excessive ingestion of nitrogenous foods.
c. In diabetes mellitus.

Low specific gravity is found in:

a. Polyuria from the ingestion of large amounts of fluids.
b. Diabetes insipidus.
c. Chronic Bright's disease.

SQUIBBS' URINOMETER.

Dr. E. R. Squibb offers a small urinometer standardized for 25 deg. C. or 77 deg. F., a temperature much more usual than 60 deg. F., and at three points, 1.000, 1.030, and 1.060, with the variations marked, whence corrections are easily made. The glass jar supplied with it is fluted and in this way the instrument is kept from clinging to the side of the glass. This object is further secured by mak-

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ing the air-chamber a double cone, base to base, instead of a cylinder. In this way, also, there is obtained a single point of contact between the urinometer and the jar. Finally the instrument is provided with a thermometer to secure

FIG. 1—Squibb's Urinometer.

FIG. 2—Doremus Ureameter.

greater accuracy, but as 4, if water be put at 1.000, is about the maximum error which can occur at any temperature at which urine is likely to be tested, it is not really necessary. This is certainly the most accurate uninometer

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I have seen; and by reason of the fluting of the glass, a smaller amount of urine is required than in the ordinary cylindrical jar.

TRANSPARENCY OF URINE.

Normally, urine is transparent when voided. If turbid this may be due to:

a. Excess of mucus,
b. Pus corpuscles or abundant epithelium,
c. Blood,
d. Phosphates,
e. Urates,
f. Bacteria.

On standing a short time these substances will settle, forming a precipitate. Mucus should not be present in an amount more than sufficient to give a slight haze. It is coagulated by acetic acid. Pus may be recognized by its becoming gelatinous on the addition of a sol. of caustic soda or potash. Epithelium and blood discs can only be verified by the microscope, although in the case of the latter the blood pigment may be identified as described elsewhere. A deposit of phosphates is cleaned up by the addition of a few drops of an

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acid and that of urates by raising the temperature.

Phosphates are never deposited unless the urine is alkaline, either when voided or by subsequent decomposition, and the presence of turbidity or sediment under these circumstances does not necessarily show that they are in excess.

Specimens turbid from urates, or giving a deposit of this substance on cooling, are always acid, frequently to an abnormal degree, and deficient in water. Such specimens are frequently observed in children; during fevers, in acute rheumatism, and after paroxysms of gout. The urates are thrown down because they are in excess relatively to the amount of urine, and usually also in an absolute way.

Turbidity due to bacteria, which are insoluble in acetic acid or heat, will not settle, nor can the bacteria be filtered out with filter paper.

If the turbidity of freshly voided urine is due to decomposition, it may be recognized from the characteristic ammonia odor, and the cause is to be sought in some inflammatory condition of the genito-urinary tract (pyelitis,

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cystitis), which favors prolonged retention of urine (stricture, enlarged prostate, etc.) or some accidental infection, as from an unclean catheter.

Pale urine indicates an excessive secretion, and suggests an examination for sugar, especially if the specific gravity is above normal. Dark urine may be due simply to diminished secretion or it may owe its color to the presence of abnormal pigment, viz.:

Pink to smoky red, due to admixture of blood,

Brown, with an easily produced yellow foam, biliary matter,

Olive-green to black, poisoning by carbolic acid and the phenols,

Yellowish brown to dark red, medication by senna, rhubarb, etc.

An abnormal color indicates the presence of abnormal constituents.

COLOR OF URINE.

The color of the urine should be determined in sunlight, *never by artificial* light. The best method is to put the urine into a test tube on foot and place it near a window.

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The normal color varies from a light yellow to a deep amber.

ODOR OF URINE.

Normally: aromatic, urinous; upon standing, ammoniacal.

If ammoniacal when voided: vesical disease, etc.

If like molasses: diabetes mellitus.

If like sweet apples: diabetic coma.

The odor is also affected by various articles of diet (e. g., asparagus) and by the administration of certain drugs.

URINE REACTIONS.

Normally the urine is acid, that is, it turns blue litmus paper red. The acidity is due to the presence of acid sodium phosphate, $Na\ H_2\ PO_4$. The urine may be alkaline in reaction, however, in which case red litmus paper is colored blue. This alkalinity may be caused by eating liberally of certain vegetables rich in alkaline salts or by taking large or repeated doses of alkaline salts themselves, as for example sodium bicarbonate or lithium tablets. When first excreted such urine is usually clear

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but it will soon become cloudy, as earthy and magnesium phosphates, as well as triple-phosphates, will separate on cooling. The alkalinity of urine may also be caused by ammoniacal decomposition, when it will always be found cloudy from the presence of bacteria and the precipitation of earthy phosphates.

When the alkalinity is caused by ammonium carbonate, the litmus paper, which first turns blue, will on drying and consequent evaporation of the ammonium salt, return to its former red color, which it will not do when the alkalinity is caused by the so-called fixed alkalies, alkaline sodium phosphate and carbonate.

We shall at times find that the same urine will turn both the red litmus paper blue, and the blue paper red, or, in other words, will be acid and alkaline in reaction at the same time. This is caused by the simultaneous presence of the acid mono-sodium phosphate ($Na\ H_2\ PO_4$) and the alkaline di-sodium phosphate ($Na_2\ H\ PO_4$) which takes place in the beginning of alkaline fermentation.

THE DEGREE OF ACIDITY of the normal urine

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varies at different times of the day, etc., and is increased:

a. Whenever the urine is concentrated, as after decreased consumption of liquids or after increased elimination of water by excessive perspiration.

b. Whenever metabolism is increased, as in fevers, or after excessive physical efforts.

c. When the ingestion of albuminous food is excessive.

THE URINE BECOMES ALKALINE:

a. When it is diluted, as when partaking of large amounts of liquids, or in cold weather when there is but slight perspiration.

b. In increased matabolism as in anemias, cardiac diseases, etc.

c. In persistent vomiting, when the normal amount of free acid of the organism is decreased by being ejected with the vomitus.

d. By increased consumption of alkaline carbonates, or organic acids and salts, which in digestion are transformed into carbonates. As an example we may instance the taking of alkaline waters, medicines, liberal fruit or vegetable diet, lemonades, sour wines, etc.,

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when the citric, tartaric or malic acids are changed into alkaline carbonates.

e. By alkaline secretions and alkaline fermentation, as in pyuria from any cause, be it pyonephritis, cystitis, or what not.

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CHAPTER III.

NORMAL CONSTITUENTS OF URINE.

UREA.

Urea, $C O (N H_2)_2$, is as we have seen, by far the most important factor in the chemical examination of urine, as the quantity excreted during twenty-four hours will more than any other one factor indicate the conditions of metabolism in the organism, or perhaps show an advanced pathological condition of the kidneys themselves. Whichever of these two conditions is the cause of the diminished excretion of urea can easily be determined by careful examination of the urinary sediment. In advanced renal disease we shall find more or less numerous fatty and granular casts and albumin, which are not liable to appear in simple, fatty metabolism.

The urea normally excreted is about 2 to 4 per cent, or about 1 ounce (30 gms.) per day for an adult of average weight. The

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excretion in childhood is relatively greater in proportion to the body weight.

There is increased elimination of urea:

a. after excessive ingestion of nitrogenous foods,

b. in fevers,

c. in diabetes mellitus,

d. in anemia and leucemia,

e. in diseases interfering with aeration of the blood.

There is diminished elimination:

a. after exclusive ingestion of carbohydrates,

b. in inanition,

c. in uremia,

d. in chronic hepatic diseases.

Estimation of the quantity may be made by the aid of Doremus' ureameter, as follows:

Make a solution of sodium hydrate, 6 ounces to a pint of water. Keep this in a bottle with a paraffined stopper.

Sodium hypobromite is prepared by adding 1 volume of bromin to 10 volumes of this sodium hydrate solution and diluting with 10 volumes of water.

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It is convenient to pour the sodium hydrate solution into the ureameter to the mark; then by means of the nipple pipette to add its measure of bromin and dilute with sufficient water to fill the long arm and bend. Tilt the ureameter and allow the hypobromite to flow into the long arm, filling it completely.

Draw the urine to be tested into the pipette to the graduation. Pass the pipette into the ureameter as far as the bend and compress the nipple slowly, the urine will raise through the hypobromite and the gas evolved will collect in the upper part of the tube.

Each division indicates 1 grain of urea in a fluid ounce of urine.

The quantity of urea voided in 24 hours is ascertained by multiplyng the result of the test by the number of ounces of urine passed during that time.

Excessive elimination of urea during the pyretic state should not cause any uneasiness on the part of the practitioner. This will regulate itself when the general condition improves.

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URIC ACID.

Uric acid, ($C_5 N_4H_4 O_3$), is the incompletely oxidized product of nitrogenous retrogressive metamorphosis, while urea represents the complete oxidation. Uric acid is always excreted in the form of sodium or potassium urate, never as free uric acid.

There is normally excreted about 8 grains or 0.4 to 0.8 grm. of uric acid per day.

Its amount is increased:

a. after albuminous food,

b. in leucemia and simple anemia,

c. in pyretic states,

d. in conditions in which respiration is interfered with,

e. in gout, shortly after the attack,

f. in epilepsy, after the attack,

g. in neurasthenia.

Its amount is diminished:

a. after a vegetable diet,

b. in gout before attack,

c. in various chronic diseases, such as nephritis, diabetes, etc.,

d. in epilepsy before attack.

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Test, qualitative:

Place some urine in an evaporating dish; evaporate to dryness. Add to the residue 1 or 2 drops of concentrated nitric acid. Evaporate again to dryness. Add 1 or 2 drops of diluted ammonia. Note the striking purple-red color, which turns violet when potash is added.

CHLORIDES IN URINE.

There is normally excreted about 200 grains or 10 to 16 grm. per day.

The amount is increased:

a. after a full meal,

b. after the excessive ingestion of table salt,

c. in diabetes insipidus.

The amount is diminished:

a. in acute pneumonia and pleurisy,

b. in dropsical conditions,

c. in chronic Bright's disease,

d. in dyspepsia,

e. in typhoid fever.

Test, quantitative:

Add a few drops of nitric acid to a little urine in a test tube. Then add some nitrate

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of silver solution. If a prompt deposit to a depth equal to about one-quarter of the urine is obtained the chlorides are present in the average quantity.

If urine becomes only cloudy without lumpy deposit, the chlorides are diminished.

If urine remains unaltered, no chlorides are present.

PHOSPHATES IN URINE.

Phosphates occurring in the human urine are all salts of the so-called tribasic or ortho-phosphoric acid ($H_3 PO_4$) and will therefore appear in three different forms. To illustrate this we may take the sodium salts as a type. Of these we shall find:

1. $Na_3 PO_4$—basic phosphate.
2. $Na_2 H PO_4$—neutral or di-basic phosphate.
3. $Na H_2 PO_4$—acid phosphate.

Only this last salt ($Na H_2 PO_4$), where only one atom of the hydrogen of the acid is replaced by an atom of sodium (Na), is acid in reaction.

It is chiefly to this salt that urine owes its acidity. The two remaining types of phos-

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phates, i. e. the basic and the di-basic, are both alkaline in reaction.

The earthy phosphates (consisting of about two parts magnesium to one part of calcium phosphate) are soluble in acid urine, especially when warm, precipitate somewhat on cooling, and completely if the urine is alkaline or even neutral.

The so-called triple phosphate is ammonium-magnesium phosphate ($N H_4$) $Mg PO_4$, which consequently is the basic salt, where one atom of H of the acid has been replaced by one atom (NH_4), which will also result from the ammoniacal decomposition of the urea.

Earthy phosphates eliminated per day about 20 grains or 2.3 to 3.8 grm.

Alkaline phosphates eliminated per day about 45 grains or 3.0 grm.

They are excreted in larger quantities:

a. in a number of nervous disorders,
b. after much mental work,
c. after an albuminous diet,
d. in diseases of the bones,
e. in diabetes insipidus et mellitus,
f. in acute fevers.

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Their amount is diminished in:

a. during pregnancy.

b. before an attack of gout,

c. in functional renal diseases,

d. diseases of the digestive organs.

The earthy phosphates are deposited from alkaline urine, but such a deposit must not be taken for an excess of phosphates. The phosphates may really be diminished, and yet in consequence of the reaction of the urine a copious deposit may be present.

Test for earthy phosphates:

Make urine alkaline with ammonium, sodium or potassium, and boil. Note white cloud, soon precipitating white or gray. This is dissolved on adding acetic acid.

Test for alkaline phosphates:

Filter off precipitated earthy phosphates and add to filtered urine one-third of its volume of magnesium fluid. Note snowy deposit, which will be alkaline phosphates.

A peculiarity of the increased elimination of phosphates in acute fevers is that especially the potassium salt (which is usually very small in amount) is increased. The earthy phos-

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phates are also markedly increased in meningitis (which has served as an aid in the differential diagnosis of typhus, where the earthy phosphates are lessened) and also in chronic articular rheumatism, rickets and osteomalacia.

THE SULPHATES IN URINE.

The sulphates appear in the urine principally in combination with the alkaline metals (especially sodium and magnesium), when a precipitate is formed on the addition of barium chlorid.

Under ordinary circumstances a small amount of sulphuric acid is combined with one of the aromatic phenyl radicles (as phenol, cresol, indol, etc.) forming aromatic, ethereal sulphates, which first have to be split up by long boiling with hydrochloric acid before they will give a precipitate with barium. This can especially be observed in cases of the dark-colored urine of carbolic acid poisoning or after prolonged administration of the salicylates, which by the usual barium test shows but a trace or total absence of sulphates. Very little clinical importance can, however, be

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placed upon the fluctuations in the elimination of sulphates and an increased amount will usually only prove increased metabolism.

The sulphates are generally excreted to the extent of about 30 grains or 1.5 to 2.5 grm. daily.

They are increased:

a. in fever,
b. in pneumonia,
c. after albuminous diet,
d. in meningitis.

They are diminished:

a. in chlorosis,
b. in carbolic acid poisoning.
c. in convalescence from fever,
d. in chronic kidney disease.

Test, qualitative:

Acidulate with hydrochloric acid and add solution of barium nitrate. Note white precipitate of barium sulphate, indicating presence of sulphates.

CARBONATES.

Carbonates of the alkaline metals and ammonia are present in alkaline urine, and may be found after a liberal diet of fruit and vegeta-

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bles, as the vegetable acids are converted into carbonates during digestion. The ammonium carbonate is formed by the bacterial decomposition of urea in cystites, etc.

TEST, QUALITATIVE:

If to some urine, containing carbonates, is added hydrochloric acid, bubbles of colorless gas will form, with more or less of a hissing sound, according to the quantity. If a clean glass rod with a drop of clear lime water dependent be held above the surface of such a urine, it will be found that the drop of lime water will become turbid from the formation of carbonate of lime.

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CHAPTER IV.

ABNORMAL CONSTITUENTS.

ALBUMIN:

Formerly only one albumin was found in urine and its presence was considered as sufficient proof of renal disease, as was its relative quantity looked upon as the gauge of renal damage. Years of careful study and research have however proven the fallacy of these views. We know now that the urine may contain almost a dozen albuminous bodies. The most important of these is serum-albumin, but we must by no means forget serum-globulin, with which it is usually associated, nor the acid or alkaline albuminates, peptones, propetones, albumose, mucin, fibrin,hemoglobin, etc., which are all more or less constant and more or less important constituents.

SERUM-ALBUMIN

is, as we have seen, the most important

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albuminous substance found in urine. Blood serum contains normally about 4.5 per cent of this serum-albumin. Serum-albumin closely resembles egg albumin in its physical properties, except that it is not coagulated by dilute mineral acids.

The occasional presence of traces of albumin in urine is of no clinical or diagnostic significance, provided the percentage of urea is normal and no casts are present. If, however, even so small a trace of albumin is constantly found in the urine of any individual, it is a never failing proof of renal pathological changes, and we can in such cases be sure to find both a decrease in the daily excretion of urea as well as some casts.

SERUM-ALBUMIN MAY OCCUR IN URINE:

a. after excessive ingestion of albuminous foods,

b. in febrile states,

c. under increased venous blood pressure (cardiac diseases),

d. after severe muscular exertion,

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e. in certain non-febrile nervous affections, as apoplexy and delirium tremens,

f. when blood or pus is present in the urine,

g. after renal irritation,

h. in diseases of the kidney,

i. in uremic conditions.

We can from the above easily see that it will be impossible to demonstrate the presence or even the extent of renal disease by simply proving the presence of albumin in the urine. The total amount of urea excreted during the 24 hours is a far more reliable proof, though constantly fluctuating, according to the peculiarities of the individual, diet, metabolism from exercise or disease, etc.

The most reliable proof of the actual condition of the kidneys is furnished by the microscope, though the presence and amount of albumin and the amount of urea excreted in the 24 hours aids in a positive diagnosis.

TESTS FOR SERUM ALBUMIN, QUALITATIVE:

1. *Heat and acetic acid.*

Put a small quantity of urine into a test tube

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and if alkaline, add a few drops of acetic acid. By holding the test tube by its lower part and heating the upper portion only, over a flame, and holding against a dark background, we can compare the upper boiled part with the lower, which will not be heated. If the urine on heating looks turbid, permit cooling and add some dilute nitric acid. If turbidity does not clear, or if it is even increased, albumin is present.

2. *Heat and nitric acid.*

Put two drachms of urine into a test tube and boil. If deposit occurs, it consists of albumin or earthy phosphates. To differentiate, add some nitric acid. If precipitate does not disappear, it is due to the presence of albumin.

3. *Heller's test.*

Fill a small test tube one-fourth full with strong nitric acid. Add to this carefully some urine by a common medicine dropper, perfectly clean, allowing the urine to run down the side of the test tube. If this is carefully done and without agitating the tube in the least, the urine, which is lighter in specific gravity than

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the acid, will form a layer above the acid. If albumin is present a white and milky ring or zone will appear at the line of contact of the two fluids. As, however, more or less cloudiness will appear from the precipitation of acid urates, albumose, resinous acids, etc., the diagnosis of albumin should be confirmed by one or two other tests before giving a decision.

4. *Pavy's test.*

Into a test tube place half a drachm of acetic acid and about three times this quantity of a solution of ferrocyanide of potash and shake.

Following this, add urine to about two-thirds the depth of the tube. If albumin be present, there will be a pale, greenish coagulum at point of contact. This is a very trustworthy test.

TEST FOR SERUM ALBUMIN, QUANTITATIVE:

Esbach's Method:

Reagent.—Picric acid .....grs. 150
Citric acid .....grs. 300
Distilled water enough to make 33 ounces.

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This test is made with the albuminometer, a standard graduated glass tube.

FIG 3.—Esbach's Albuminometer.

Fill albuminometer with urine to letter U, add reagent to R; close tube with stopper and shake thoroughly. Set tube aside for a day and read off percentage of albumin contained in urine.

The tubes are graduated to read the number of grams of albumin to 1000 cc. of urine. Percentage is readily calculated by removing the decimal point one figure to the left; for instance, 1 gram for 1000 cc. would be 0.1 per cent of albumin.

SERUM-GLOBULIN.

Serum-globulin very frequently is associated with serum albumin in the urine. As it is practically insoluble in pure water its presence can be demonstrated by Hammarsten's test, i. e., if a clear specimen of urine is diluted

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with an excess of water, it will become slightly hazy if serum-globulin is present.

MUCIN OR NUCLEO-ALBUMIN.

Mucin, or more correctly, nucleo-albumin, is always present in urine, but may be of pathological significance only if occurring in excessive amounts.

Its presence in large quantity indicates a catarrhal condition of some portion of the genito-urinary tract, and we are likely to find the urine of alkaline, or at least but faintly acid reaction. In some instances of alkaline urine it may be "stringy" or almost gelatinous from excess of mucin.

Tests.—Add lime water; it is dissolved easily. Alcohol and acetic acids form a precipitate, which is soluble in lime water.

PEPTONES.

Peptones are sometimes found in otherwise normal urine, but usually accompanying toxemias, whether of the infectious diseases or from phosphorous poisoning, absorption of extensive exudates, in the involution of the puerperal uterus, etc. It may be looked for as a

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consequence in all diseases associated with the disintegration and absorption of leucocytes and exudates and also in the localized inflammations of a purulent tendency. Peptones are not precipitated by heat, acids or ferrocyanide of potassium and acetic acid.

PROPEPTONE AND ALBUMOSE.

Propeptone and albumose are found in the same class of cases as peptones and also in gastric and intestinal ulcers, multiple myeloma, urine containing seminal fluid, etc. Propeptones and albumose are precipitated by strong acids; are redissolved by heat, but precipitate again on cooling. They are also, in contradistinction to peptones, precipitated by ferrocyanide of potassium and acetic acid.

TEST FOR PEPTONES AND ALBUMOSES.

Treat about one pint of urine with neutral acetate of lead and filter clear. The filtrate is then mixed with almost an equal volume of strong hydrochloric acid, after which phosphotungstic acid is added till no further precipitate occurs. This precipitate, which consists of peptones in combination with the phospho-

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tungstic acid and some other substances, is now quickly washed with 5 per cent sulphuric acid until the washings are clear. The precipitate is then removed from the filter into a porcelain dish with as little water as possible, after which dry barium carbonate and some water is added until the mixture becomes alkaline. After heating this mixture on the water bath for 15 to 20 minutes the precipitate is filtered off and the filtrate will, after being made strongly alkaline with liquor sodii or potassii, show a bluish red or violet color on the addition of a drop or two of a 10 per cent solution of copper sulphate. If no peptones are present, the solution assumes a green color on the addition of the copper solution.

FIBRIN.

Fibrin occasionally is found in urine in cases of hematuria or chyluria in the form of casts or coagula. It is also occasionally found after the use of cantharides, turpentine and other substances, that cause acute renal irritation.

CHYLE.

Chyle is occasionally found in urine, especially in tropical countries. Chyluria or galac-

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turia is frequently associated with the presence in the blood of filaria sanguinis hominis, but has been found repeatedly in other conditions and in people who have never visited a tropical country. Such urine is more or less milky, opaque or pinkish in color; is of low specific gravity, though the urea is normal. The opacity depends to the greatest extent upon fine, granular fat globules, but also partially upon leucocytes, etc. Chylous urine contains also albumin, fibrin, lecithin and blood cells.

By shaking chylous urine with ether, the fat will be dissolved, and can be both qualitatively and quantitatively determined by evaporating the ether and weighing the fat obtained from a known quantity of urine. The amount of fibrin is sometimes very high in chyluria and will occasionally form large coagula upon shaking. In lymphus urine the percentage of albumin and fibrin is so large that the urine coagulates spontaneously, and Neubauer relates a case where the coagula formed partly within the urinary passages, actually interfering with urination.

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GLUCOSE IN URINE.

Grape sugar or glucose ($C_6H_{12}O_6+H_2O$) is at times found in urine as well as (though in smaller quantities and of less clinical importance) levulose or fruit sugar, inosite or muscle sugar and lactose or milk sugar. The claim of some investigators that a trace of sugar is found in all normal urine has been repeatedly disputed. As, however, even if such were the case, only actual glycosuria is important to the diagnostician, we can with the tests given below feel certain of sufficient accuracy for all practical purposes, as diabetic urine contains from 1 to 4 per cent and even in some cases as high as 5 or 6 per cent, or even more. Every specimen of urine of 1.025 or even 1.020 spec. gr. should be tested for sugar, especially if pale in color and increased in amount. The occurrence of sugar in urine may be classified under the following headings:

(a) PHYSIOLOGICAL GLYCOSURIA, as after the ingestion of abnormal quantities of sugars or starchy foods, especially in elderly people, whose appetite for carbohydrates is greater than their digestive powers.

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(b) TEMPORARY GLYCOSURIA, as in:

(1) Many infectious diseases, such, for instance, as erysipelas, typhoid, typhus, cholera, scarlatina, etc.

(2) in some acute febrile conditions, as acute articular rheumatism.

(3) in diseases of the heart and lungs, cirrhosis of the liver, after paroxysms of whooping cough, asthma and epilepsy, etc.

(4) after chloroform narcosis, inhalation of carbon dioxid, and certain drugs.

(5) in certain nervous affections, and after bulbar hemorrhage, when the floor of the fourth ventricle is injured or irritated.

(c) LACTOSURIA may at times be found in nursing mothers.

(d) PERMANENT GLYCOSURIA is the disease known as diabetes mellitus, when the percentage of grape sugar is dependent upon the amount of carbohydrates of the food.

TESTS FOR GRAPE SUGAR, QUALITATIVE.

1. *Bismuth test* (*Bottger's*).

Put one drachm of urine into a test tube, add equal amount of liquor potass.; also some sub-

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nitrate of bismuth. Boil gently. If glucose is present precipitate of gray or black will appear, according as there is a small or large amount of glucose present.

2. *Ammonium hydroxid test.*

Take 1 drachm of urine and add equal amount of ammonium hydroxid; then add 5 drops of a strong solution of lead acetate. A white, flocculent sediment appears at once. Gently heat part of the sediment until two or three boiling bubbles ascend. If glucose is present there will appear on the heated place of the sediment a distinct pink spot, the intensity of which is dependent upon the amount of grape sugar present; as minute a quantity as only 0.1 per cent of grape sugar is thus shown.

3. *Haines' test.*

Reagent.—Copper sulphate .....grs. 30
Distilled water .....oz. ½
Make a perfect solution and add:
Pure glycerine .....oz. ½
Mix thoroughly and add:
Liquor potass .....oz. 5
This solution does not alter.

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of Fleischman's or some other good compressed yeast, after which the mixture is poured into the bulb of the instrument. By inclining the saccharometer the mixture flows into the upright cylinder, driving out the air. The whole is now left undisturbed for from 18 to 24 hours in a room of even, ordinary temperature. If the urine contains sugar, we will within this time find that the upper portion of the liquid in the tube has been replaced by carbonic acid gas, resulting from the fermentation of the sugar, and the approximate quantity of sugar is found by reading off the amount of CO_2.

If the urine contains more than 1 per cent of sugar it must be diluted with from one to ten times its amount of water, and the percentage of sugar multiplied from one to ten times, as the case may be.

Another fairly accurate and very simple fermentation determination is to first take the specific gravity of the specimen suspected. Add to this some Fleischman's compressed yeast and set aside to ferment for twenty-four hours at a temperature of about 85 degrees F. Then

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take again the specific gravity of the fermented specimen, subtract the latter specific gravity from the original. For every degree of specific gravity lost we have one grain of sugar to the ounce of urine, provided we have taken the specific gravity at the same temperature. If, for example, the specific gravity of the original specimen was 1.025, and after fermentation for twenty-four hours the specific gravity is only 1.018, we have seven grains of glucose to the ounce of urine, and by multiplying the number of ounces of urine passed during the twenty-four hours with seven we have the amount of glucose passed in the same length of time.

QUANTITATIVE ANALYSIS OF GLUCOSE BY COPPER SOLUTION.

Boil in test tube or flask any convenient number of drachms of Pavy's solution diluted with an equal bulk of water. Drop in slowly from a burette or other accurate measuring vessel the urine to be tested. When the blue color has just disappeared, note the amount of urine used. For every drachm of Pavy's solution reckon 1-3 grain of glucose; for example, if 4 drachms of Pavy's solution require 120 min-

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ims of urine, then 120 minims contain 4.3 grains of glucose, or 5 1-3 grains per fluid ounce.

Similarly, if 10 cubic centimeters of the mixed Fehling's solution requires 5 cc. of urine, then as each cc. is decolorized by 5 milligrams of glucose, there are 50 milligrams of glucose contained in 5 cc. of urine, or 1 per cent (0.050-5.000, 1-100).

PIGMENT CHANGES.

BILIARY PIGMENT.

Occurs in urine in affections of the liver and gall ducts, and in certain toxic conditions:

Put a few drops of the urine on a white dish, and bring into contact with it a drop of nitrous acid. A play of colors will be observed, green (biliverdin) predominating.

BLOOD PIGMENT.

Shake a small portion of the urine in a test tube with a little fresh tincture of guaiac and a few drops of spirits of turpentine. The latter should be an old sample which has been freely exposed to the air. Or it may be replaced by a few drops of peroxide of hydrogen. The mix-

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ture will shortly assume a blue color. *Pus,* if present, should be allowed to separate from the suspected urine, as it also gives the above reaction.

INDICAN.

Add to the urine an equal volume of hydrochloric acid, and slowly add a few drops of liquor sodae chlorinatae—a blue color results.

The following is a good test for Indican: Twenty (20) c. c. of the urine is gently shaken with a few drops of sulphuric acid, five (5) c. c. of chloroform and five (5) c. c. of a 10 per cent solution of sodium persulphate. The indigo thus generated dissolves in the chloroform, coloring it a more or less deep blue, according to the amount present.

This pigment is normally present to the extent of a trace, but a well-defined reaction indicates albuminoid decomposition within the body, due to constipation, obstruction of the bowels, purulent accumulations, etc.

The remaining organic constituents are of no significance, and as the care necessary for their separation is more than can generally be

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given by the physician we will mention them very briefly.

Creatinin is excreted in about the same proportion as is uric acid, and is found to be less when a vegetable diet is partaken of than when an animal diet prevails. The quantity is increased in pneumonia, in intermittent fevers, in typhus and in kidney diseases in advanced stages; diminished in inanition.

Hippuric acid is present in small quantities only in the human urine; is increased by vegetable diet, in febrile conditions, diabetes and after the injection of benzoic acid. It is diminished by a strict diet of meats.

Xanthin is found in very small quantity.

Oxalic acid is found always as the oxalate of calcium, which will be treated of elsewhere in this work.

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CHAPTER V.

THE MICROSCOPE AND MICROSCOPICAL TECHNIQUE.

No one article is of such importance in proper urinary diagnosis as a good microscope of sufficient magnifying power. The first cost of such an instrument is greater than all the other apparatus and reagents necessary for thorough clinical urinary examination. Competition and improved methods of manufacture have, however, of late combined to reduce the price considerably, and it is now possible to get a very good instrument comparatively reasonable. It will be found that the size of most pathogenic micro-organisms is so minute that a 1-12 inch oil immersion lens (magnifying from 800-1000 times according to objective, or eye-piece) is indispensable for their detection and study. The structure of casts, blood and certain salts can be made out properly only by similar magnifying power, though for the

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first, hasty routine examination a 2-3 or 1-6 inch objective is serviceable.

It is needless to say that the greatest care must be taken with the microscope, and especially the lenses, as the most minute scratch is a hundredfold magnified. After each examination under oil immersion the cedar oil should be carefully removed with a fine cloth, before it dries on the lens. The greatest care and cleanliness must also be observed in the preparation of the specimen to be examined. The cover slip and slide must be carefully cleaned, as also the pipette or glass-rod with which the drop is applied to the slip. The fingers must not be allowed to touch the slide or slip. The specimen should not be too thickly applied. If the specimen is too dense, take a new one and dilute with a minute quantity of clean water.

With reasonable care and some experience the average practitioner will soon find his labors rewarded by the great, new field of possibilities opened up to him in his search for knowledge and positive diagnosis.

THE CENTRIFUGE.

The centrifuge is now recognized as an es-

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sential and time-saving means of producing sedimentation of all solids of the urine, whether of crystalline substance or of blood, pus or bacteria. A description is hardly called for

FIG. 5—The Centrifuge.

here, as it is presumed that so valuable an assistant to urinary analysis is pretty generally well known.

When used the centrifuge should be kept

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at a speed of from 1,200 to 1,500 revolutions per minute for at least three minutes, or until sedimentation is complete. The amount of total sediment is then read off from the graduated scale on the glass tube. A pipette, closed

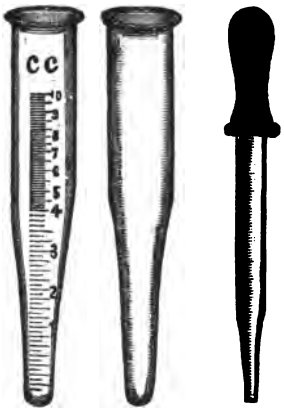

FIG. 6—Glass Tubes and Pipette used in the Centrifuge.

at the upper opening with the forefinger, is introduced into the tube to a point near or quite to the bottom; the upper opening made free for an instant, closed again by the forefinger, and the pipette withdrawn. Transfer a small quantity of the contents to a glass slide upon which a circle has been made with ce-

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ment, and allowed to dry; this is then covered with a clean glass cover, and the excess of fluid removed with white blotting paper. The specimen is now ready for examination with the microscope. In some instances, or when bacteria are sought for, the specimen will have had to be stained, as will appear later. If the centrifuge shall not have been used, the urine to be tested should be first placed in a conical glass, tapering to a point at the bottom, covered with a clean glass plate or watch glass, and set aside until the solid particles shall have subsided to the bottom. Then proceed to secure a portion of the sediment with the pipette, etc., as before described.

URIC ACID.

Uric acid, if not already recognized macroscopically, will appear in crystalline form. They are described as rhomboid or six-sided, or, other forms, as ovoid or whetstone shape, and are of varying sizes. Occasionally they resemble in shape sections of barrels, envelopes, spears, a fan or a fine tooth comb with teeth on both sides. Again they appear dumb-bell in shape. They are colored,

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varying from a pale yellow to a dark red or brown, are often aggregated or rosette in appearance.

The application of the murexid test to uric acid crystals will remove any doubt as to their character by the well known display of colors.

URATES.

The urates are mostly amorphous, and consist mainly of the acid sodium urates; are sometimes accompanied by small quantities of potassium, ammonium or calcium urates; are generally yellow or red, and are known as "brick dust deposits." (see figure.) Urine rendered cloudy by the presence of amorphous urates, becomes clear by addition of a drop of acetic acid, or by heating. Crystalline urates occur in urine which has undergone fermentation, and in the form of prisms, or stellate bundles. When the fermentation has gone so far as to produce ammonia, the crystals will be highly colored and spherical in shape, but without spines.

OXALATE OF LIME.

(Calcium Oxalate.)

Oxalate of lime may occur in either acid or

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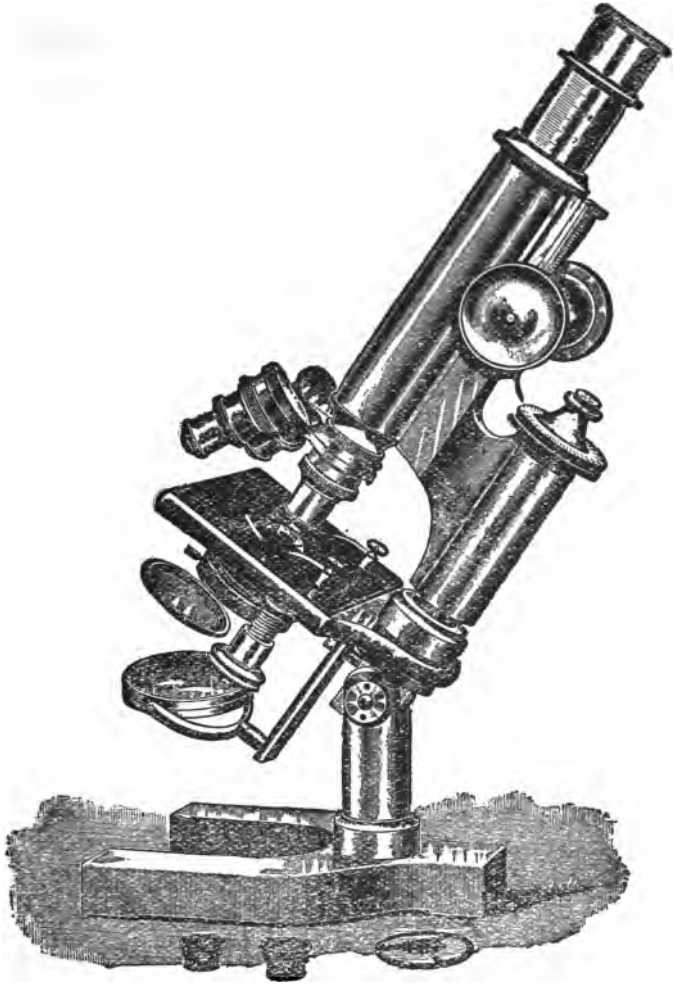

FIG. 7—A Model Microscope.

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sometimes mistaken, is insoluble in ether, but soluble in caustic alkalies.

CYSTIN.

Cystin occurs rarely in urine, but when it does it appears as a light yellow deposit. It may be found in both acid and alkaline urine, and shows as hexagon plates placed one upon the other. Cystin develops in decomposing urine a strong odor of sulphuretted hydrogen; is soluble in ammonia and insoluble in boiling water or acetic acid.

MUCUS AND PUS.

Mucus and pus will be found as round granular cells, somewhat larger than blood corpuscles. Mucus will appear as a delicate cloud,

Pipette.

descending towards the bottom of the container. Upon the addition of acetic acid mucin will be formed, which is not coagulable by heat, is precipitated as delicate fibrillated bands, sometimes having the appearance of threads and again tortuous in shape. If iodide of potassium

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is added to acetic acid and applied to the specimen, the thread will become more distinct. Mucus contains no albumin, while pus does; therefore, so long as albumin does not appear in urine, pus may be excluded.

Pus in the urine may come from any part of the genito-urinary tract; a diseased prostate, gonorrhea, leucorrhea, or other discharges from the vagina.

Some pus cells or leucocytes are often present in otherwise perfectly normal urine. If, however, any considerable number is to be seen, a suppurative condition of some part of the genito-urinary tract is certain. As some of the causative conditions we may enumerate: Pyonephrosis from any cause, cystitis, urethritis, prostatitis, vaginitis. The prime causative micro-organism may be almost any form of bacterial life, but we usually find either gonococci, tubercle bacilli, coli communis, typhosus, strepto or staphylococci, though many bacteria are usually also present.

Leucocytes are generally easily recognized by the microscope in acid and neutral urine, while in alkaline urine they appear more or

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less formless and swollen. The addition of a drop or two of a 1 per cent acetic acid solution is, in such cases, usually all that is necessary to clear them up sufficiently to make their nucleus visible.

EPITHELIAL CELLS.

Epithelial cells, when met with in urine, are of three varieties: the round epithelial cells, the columnar or conical epithelial cells, and the flat epithelial cells.

The round epithelial cells come from the convoluted tubes, the pelvis of the kidney, the bladder and the male urethra. They are rounded, granular bodies, somewhat larger than pus-corpuscles, and contain a single nucleus.

Columnar epithelial cells come from the pelvis of the kidney, the ureters and the urethra, are elongated, conical bodies, granular and have a nucleus in the center.

Flat epithelial cells proceed from the bladder and the vagina, are large, irregular, scale-like bodies, and contain a single nucleus.

BLOOD CORPUSCLES.

Blood corpuscles come from the pelvis of the kidney, the bladder, the prostate, from the

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uterus or the vagina. When occurring in urine in large amounts, the urine will be red. If the urine should be acid, it will be a blackish brown or smoky color. If alkaline, it will be in appearance a bright red. Urine containing blood visible to the naked eye will be albumin-

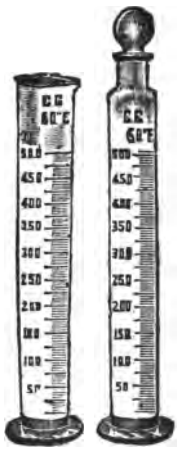

FIG. 10—Graduated Measuring Glasses.

ous. If blood corpuscles are in quantity sufficient to produce a deposit of a brownish red mass at the bottom of the container, they are almost certain to proceed from the kidney. If they come from the bladder or urethra they

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will appear as coagula. If they appear as moulds of clotted blood, nephritic colic is to be diagnosed.

Blood corpuscles may be diagnosed by the reversal of light and shadow as the slide is made to approach or is withdrawn from the object glass.

TUBE CASTS.

Tube casts are cylinder moulds from the uriniferous tubules, and appear as

a. epithelial casts,
b. blood casts,
c. hyaline casts,
d. granular casts,
e. fatty or oil casts,
f. waxy casts.

They are said to be produced by admission into the tubules of the coagulable portions of the blood, where they solidify; are detached by liquid, which is followed by contration of the tubules, discharged through the pelvis of the kidneys into the bladder, and from thence voided with the urine.

If the tubes are filled with detached epithelium which is later discharged, we will have

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epithelial casts. If the tubules contain blood, we will have *blood casts.* If the epithelium be attached to the tube and is discharged alone and after the epithelial cast, we have the *hyaline casts.* If the cast contains granular substances, it is known as the *granular cast.* If it contains quantities of oil drops, it is called a *fatty* or *oil cast.*

A cast which is solid and has the appearance of wax is called a *waxy cast.* If the tubule is first filled with leucocytes and afterwards discharged, we have another variety not enumerated above, and known as the *pus cast,* but this variety is rarely met with.

THE COMPARATIVE NUMBER AND KIND OF CASTS FOUND, TOGETHER WITH THE AMOUNT OF UREA EXECRETED IN THE 24 HOURS, ARE THE BEST INDICATORS AS TO THE PATHOLOGICAL CHANGES THAT HAVE TAKEN PLACE IN THE KIDNEYS, and the importance of a thorough microscopical study of the urinary sediments can, therefore, not be overestimated.

A few words on the pathology of nephritis may not be out of the place, in order properly to elucidate this point.

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In acute cases of primary nephritis—acute parenchymatous nephritis—following a severe cold, especially during or after a debauch, when excessive ingestion of alcohol adds its specific irritating effect on the renal structures, there is marked dilatation of the renal vessels with corresponding exudation into the tubes. Some of the capillaries of the Malpighian tubes may rupture, whereby blood corpuscles and serum will escape forming the *"blood casts,"* so characteristic of early and acute cases, besides the *hyaline casts,* which is the exudate.

This condition,—no matter how acute,—is likely to subside under appropriate nursing and treatment without leaving the renal functions appreciably impaired. In the less acute cases, —known to the pathologists as *subacute Bright's disease* with large, white kidneys,— there is a proliferation or catarrhal condition of the tubal epithelium with, undoubtedly, the addition of leucocytes. The epithelial cells are swollen ("cloudy swelling") and fill some of the tubes more or less completely. As we always in these conditions may expect more or less exudation, we are certain to find in the

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urinary sediment both *epithelial and hyaline casts.*

The prognosis in such a condition must necessarily vary. The hyperemia and epithelial proliferation may almost totally subside without doing much damage to the excretory epithelium, or else the vitality of the epithelium is impaired to such a degree that we shall find fatty degeneration of some of the epithelial cells, which degeneration increases according to the damage wrought; and we find *fatty,* as well as *granular casts* in more or less abundance. According to the duration or frequency of recurrence of such attacks, more or less of the intertubular connective tissue also becomes involved in the inflammation. New connective tissue is formed, which is gradually replaced by scar tissue, which contracts and interferes with the circulation of the adjacent vessels. This *interstitial nephritis* causes more or less irregular contraction and atrophy of the organ (small, white kidney). As the inflammation is not of an acute character, a chemical examination of the urine of such an individual will show *but a trace of albumin and but few*

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casts. As, however, the renal excretory apparatus, which is the epithelium, is impaired, *the amount of urea* in such a urine *is decreased* and the *renal permeability is also decreased.*

It is again but natural that we should find abundant albumin, as well as casts, in acute nephritis, with an intermediate amount of both in the subacute cases. It is unnecessary to add, that these inflammatory processes, be they of the parenchyma or the interstitial tissues, be they acute, subacute or chronic, will vary in different individuals and from different causes. As, however, a more extended review of the subject is beyond the scope of this work, the student is referred to the text-books on pathology for further information on this important and interesting topic.

SPERMATOZOIDS.

Spermatozoids often occur in the sediment of urine of perfectly healthy men, and will be recognized by the oval head with a delicate tail or tadpole-like body.

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CHAPTER VI.

BACTERIA.

Cohn classifies the fungi found in the urine as:

(a) Spherobacteria or micrococci.

(b) Microbacteria or rod bacteria.

(c) Desmobacteria or filamentous bacteria with a subdivision of the latter:

1. A straight form, the bacillus.
2. A curved form, the vibrio.

TECHNIQUE IN STAINING AND EXAMINATION OF BACTERIA.

Place upon a perfectly clean and dry cover-slip a very minute drop of the specimen to be examined. Spread this carefully over the slip with a platinum wire (sterilized by holding it over a gas, or alcohol flame for a moment, and then allowing to dry. Evaporate the moisture by holding the slip some distance over the flame. When thoroughly dry, pass the slip, now held by forceps (and with the side upon which the specimen is spread upward), quickly

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through the flame three times, allowing about one second for each fire bath. The object of this "fixing" process is to coagulate the gelatinous coating of the bacteria, when they will adhere to the glass, and not be washed away by the subsequent proceedings. When the specimen is thus "fixed," and the glass cool, add a few drops of Loeffler's or Ziehl's solution. After, say, thirty seconds, the slip is gently rinsed in water and then, without drying, placed upon a clean glass-slide, bacteria down. The excess of fluid is removed by blotting paper, so that the upper side of slip is dry. Now put a small drop of cedar oil on upper side of slip, and examine with the oil-immersion lens, when the bacteria will be easily seen.

If it is desired to mount the specimen for preserving, it is best to allow the slip to dry after rinsing off superfluous stain, and then place a small drop of Canada balsam upon its bacterial side, after which it is inverted upon the glass-slide.

There is a great variety of bacilli, as well as cocci, present in the urine of most cases of

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cystitis. To properly diagnose the special kinds, quite extensive bacteriological procedures are necessary, which are beyond the skill and time of the average practitioner.

Bacilli increase by transverse division, and often form long strings known as *leptothrix*. It is not constricted at the joints as are the *moniliform* threads sometimes formed by globular bacteria. The first two are isolated, and consist of jelly-like masses.

Bacteria in urine cause a cloudy appearance which cannot be entirely removed by filtration, but may be by heat and by precipitating the phosphates with a few drops of caustic soda solution, when the bacteria are carried down with the precipitate.

The examination of urine for bacteria in general has to be made with a $\frac{1}{2}$-inch oil immersion lens, as bacteria are too small to be well seen by a smaller magnifying power. The staining of specimens containing bacteria, for clinical purposes, can usually be very easily accomplished with but few accessories, and the simplest and best method for general diagnostic purposes may be given in a few lines,

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with the understanding that reference to the text-books on Bacteriology is necessary for more extended information on the subject.

GONOCOCCI

are diplococci consisting of two hemispheres with their flat sides adjacent. They show oscillatory and rotary movements, and are usually enclosed in pus and epithelial cells. Their presence confirm a diagnosis of gonorrhea.

THE BACILLUS TUBERCULOSIS

is found in urine more readily since we have the assistance of the centrifuge. When sought for, a portion of the sediment, from the centrifuge or other glass, should be placed on a clean slide at ordinary temperature, and fixed over the flame from a spirit lamp, stained with fuscin, decolorized with an alcoholic solution of nitric acid ($HN\ O_3$) and examined with immersion lens.

STREPTOCOCCI

are micrococci, growing in chains, giving the appearance of a string of beads. Their increase takes place by segmentation in one direction only. Regarding the pathogenic qualities

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of the various streptococci, the reader is referred to the text-books on Bacteriology.

STAPHYLOCOCCI

appear as individual cocci, alone, or in clusters, but not in chains. They segment by division into pairs or fours.

YEAST FUNGUS.

This fungus is found in saccharine urine. They are small oval cells, and often arrange themselves in rows of two, three or more, as seen in illustration elsewhere.

PENICILLIUM GLAUCUM (BREAD MOULD).

Occur in acid urine with or without albumin or sugar. They furnish cells similar to yeast fungi in the sporule-stage; later there is union of cells which form branches brush like, characteristic in appearance.

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CHAPTER VII.

THE QUALITATIVE ANALYSIS OF URINARY CALCULI.

The more common forms of urinary calculi are those of:

a. Uric acid and its various compounds,
b. The oxalate of lime,
c. The mixed phosphates,
d. Occasionally xanthin and cystin.

The specimen to be examined is to be first powdered and portions from the different layers preserved and analyzed separately, as the chemical composition differs often in different parts of the calculus. First heat a portion of the powder on platinum foil or in a platinum crucible, over a dull red heat for a considerable time, or until it becomes colorless. If there remains only a small amount of residue it will indicate that the stone is composed of uric acid or of ammonia urate. To the residue apply the murexid test. If a purple color develops, you will be certain that the specimen is com-

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posed of uric acid. A further test will be in the absence of an ammonia odor during the heating. If a strong ammonia smell is developed you will conclude that the specimen is one of ammonium urate.

If a yellow flame is produced during the application of a flame from the blow pipe you will have sodium urate. If a violet color, potassium urate.

Dissolve a portion of the residue in dilute hydrochloric acid, add ammonia solution until alkaline, then add ammonium oxalate. If a white precipitate is formed you will have calcium urate.

If there be no precipitate, add sulphuric acid; neutralize with ammonium hydroxid. If then a white precipitate is formed by the addition of disodic phosphate, you will have magnesium urate.

If a portion of the calculus melts under the flame of the blow pipe, but does not produce a purple color, treat the residue with acetic acid; afterwards add solution ammonia to excess. A white crystalline precipitate indicates *ammonio-magnesium phosphate.* If the residue is in-

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soluble in acetic acid dissolve in hydrochloric acid, and add to the solution, ammonia. If a white precipitate appears, you will have calcium phosphate.

If the specimen does not melt under the flame of the blow pipe, test with red litmus paper; and if alkaline treat with hydrochloric acid and afterward add excess of solution ammonia. A white precipitate will indicate calcium phosphate. If there is no fixed residue, mix a portion of the powder with lime and moisten with water. If there develop an odor of ammonia, and red litmus paper is turned blue, you have ammonium urate. If no ammonia is developed, uric acid. If no purple color is produced, treat with nitric acid. If it turn yellow as evaporated and remaining portion is not soluble in potassium carbonate, you have xanthin. If the nitric acid solution turns dark brown on evaporation you have cystin.

THE DIAZO-REACTION.

The diazo-reaction in the urine of those suffering from typhoid fever is produced as follows: First a solution containing a satu-

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rated solution of sulphanilic acid in a solution of hydrochloric acid (50 c.c. to 1,000 c.c.); another solution, a half-per-cent solution of sodium nitrite. Take a few cubic centimeters of urine, place in a small test tube with an equal quantity of a mixture of the solution of the sulphanilic acid (40 c.c.) and sodium nitrite (1 c.c.), the whole being well shaken. One c.c. of ammonia is then allowed to flow carefully down the side of the tube, forming a colorless zone above the yellow urine, and at the junction of the two a deep brownish red ring will be seen if the reaction be present. With normal urine a lighter brownish ring is produced without the shade of red. The color of the foam of the mixed urine and reagent, and the tint which it produces when largely diluted with water, are characteristic, being in both cases of a delicate rose-red if the diazo-reaction be present; if not, the color will be a brownish yellow.

The toxicity of urine in typhoid fever is very much increased. It has been stated that many patients, convalescent, have a urine containing large numbers of the typhoid bacillus, and

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it is also declared that the bacillus may be found in the urine of those recovering from typhoid for months after convalescence. The urine should always be thoroughly disinfected by corrosive sublimate or carbolic acid.

RENAL PERMEABILITY.

Renal permeability has lately been found one of the best aids in the diagnosis of interstitial nephritis, and a few words on the subject may be opportune. It has been found that if a patient with interstitial nephritis, after first urinating, be given about one grain of methylene blue, enclosed in a gelatine capsule, it will take from 3 to 12 hours before the urine shows any of the greenish discoloration.

The patient must be instructed to attempt micturition half-hourly, besides closely watching for and noting the time of change of color of the urine voided. The normal kidney excretes the drug in from one-half to two hours, while all color disappears in from twenty-four to ninety hours. In renal coagestion, acute and subacute parenchymatous nephritis, the color appears even earlier than when the kid-

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neys are normal, and the time of elimination is shorter. As the time before any discoloration appears is lengthened in interstitial trouble, so is also the time for total elimination prolonged and it may take several days and even weeks before the color entirely disappears. Though this test for renal permeability is still rather crude, and as yet not sufficiently studied, still it has its great usefulness and deserves its place in ordinary diagnosis.

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CHAPTER VIII.

BRIGHT'S DISEASE, DIABETES, GOUT AND OTHER CONDITIONS.

BRIGHT'S DISEASE.

Bright's Disease is any disease of the kidneys marked by the persistent presence of albumin in the urine, and attended by disintegration and wasting of the organs. It occurs in two forms, acute and chronic. The acute form is accompanied by changes in the epithelial, vascular and intertubular tissues of varying intensity, and is often caused by exposure to cold or wet. It may follow overindulgence in intoxicants, or scarlet fever, measles, diphtheria, typhoid fever, meningitis and malaria. Certain chemicals and medicines, such as chlorate of potassa, carbolic acid, turpentine and cantharides, will produce a nephritis. Albuminuria will sometimes accompany pregnancy.

Acute nephritis is usually ushered in by chills, pain over the kidney, elevation of temperature, at first scanty urine which is highly colored from the presence of blood. There are

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large quantities of albumin, tube casts, and consequently high specific gravity.

The color will vary in intensity from the normal to a dark brown, and will have often a smoky hue. The deposit will show when examined by the microscope, blood corpuscles, epithelium, hyaline, tube and blood casts. Uremia will sometimes follow an attack of diphtheria, scarlet fever and measles, where there has been subsequent albuminuria.

Chronic Bright's Disease may follow an acute attack, a free indulgence in alcoholic stimulants and gastro-intestinal disturbances. There will be a diminished amount of urine, somewhat yellow in color and turbid from urates. Upon standing, it will deposit a heavy sediment, which the microscope will show contains tube, hyaline, epithelial and granular casts, with leucocytes, blood corpuscles and abundant albumin. Specific gravity will often reach 1.025. There will be puffy eyelids and a pallid skin, gastro-intestinal disturbances, etc.

THE TREATMENT OF BRIGHT'S DISEASE

varies according to the degree and circumstances. In acute cases, where there may be

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almost anuria, or threatened convulsions, the first thing is to cause rapid, free and watery catharsis, with croton oil 2 or 3 minims, mixed with olive oil, given far back on the tongue; repeated doses of elaterin gr. 1-12, or repeated, concentrated solutions of magnesium sulphate.

Diaphoresis should be established by hot baths, hot packs (by wrapping the patient in a blanket wrung out of hot water, over which several other blankets should be added), hot air baths, etc. Hot air baths can easily be improvised by suspending a rubber-horse-blanket or oilcloth over the patient's body on barrel-hoops. Several blankets are placed over this most carefully, so that only the patient's head is uncovered. At the foot of the bed a common stove-pipe elbow is introduced, and the heat from a good lamp is allowed to enter through the pipe. If the patient is able to swallow, a hot lemonade will aid the diaphoresis, and at the same time act as a diuretic.

Pilocarpine may have to be given hypodermatically in the dose of 1-10 to 1-6 gr., but great care should be used in its employment. After good, thorough diaphoresis is estab-

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lished, the patient is wrapped with several dry and warmed blankets without underclothing.

As diuretics, besides large quantities of water, alkaline mineral waters, lemonade and buttermilk, citrate of potassium in 15 to 30 grain doses may be administered every few hours.

Too much stress cannot be laid upon the fact that water, per se, is the best diuretic, and should be partaken of liberally.

If the patient is unconscious and unable to swallow, normal salt-solution may be given by infusion into the cellular tissue under aseptic precautions, or as an *enema,* high up in the colon, through a long, rectal tube.

The diet in all forms of nephritis should consist mainly of milk, 2 to 4 quarts daily. After the acute symptoms are relieved farinaceous foods, eggs, fish, oysters, fruits and broths may be added to the dietary, but meats should be avoided as far as possible, even in chronic cases.

Coffee, tea and alcoholic beverages are to be prohibited.

In chronic cases (and even at times in acute) the infusion of digitalis will be found beneficial.

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Iron, in the form of Basham's mixture, or otherwise, is indispensable in chronic nephritis, as are warm baths and prophylaxis against colds, by warm clothing, avoidance of draughts and sudden changes of temperature.

Diuretin, in doses of 20 to 40 grs., and glonoin, in 1-100-gr. doses, repeated every two or more hours, will sometimes be found very useful to relieve the dropsy.

DIABETES.

Diabetes insipidus is always a chronic disease and is characterized by the passage of large quantities of urine, which, excepting for a lowered specific gravity, is normal in character, while diabetes mellitus is a disorder of nutrition in which the urine contains variable amounts of grape sugar. Diabetes insipidus may exist for years without serious impairment of health. It occurs mostly under 25 years of age, and is thought to be a disease of nervous origin originating through a vasomotor disturbance. The polyuria is best controlled by valerian, strychnin, arsenic, ergotin or antipyrin.

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DIABETES MELLITUS.

Elsewhere will be found tests for the presence of grape sugar in the urine (diabetes mellitus), and as the etiology of the disease producing it is fully treated of in the text-books, and other works upon general practice, only a brief resume of the latest writings regarding the rationale of the treatment will be given.

The aim has heretofore been to eliminate all the sugar-forming substances from the diet of diabetic patients, but recent study has demonstrated that a goodly number of these cases do better when allowed a moderate amount of these substances. It is clear that the question of the elimination of the carbohydrates in these cases is not the *sine qua non* of treatment; there are other elements to be considered than the non-production of sugar. The patients will have, as a rule, an accentuated appetite, and in some instances a craving for starches and sweets, due to the enormous elimination of sugar and a consequent demand for water as well as for materials with which to manufacture sugar. The main object will be in the treatment of such cases to avoid the excessive

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consumption of food by which the digestive organs are overtaxed and functional disturbances brought about.

The diet should be a mixed one in which a diminished amount of carbohydrates is aimed at, but not such as to eliminate them entirely. Fermentation should be avoided and the bowels kept free.

Opium or preferably codeia and antipyrin will favorably influence the disease and diminish the production of sugar. Benzosol has also been successfully used. Iron and arsenic will be found useful as tonics.

Liberal quantities of pure water should be allowed because of its mechanical effects in flushing the kidney, and thus getting rid of the accumulated sugar.

It has been claimed that micro-organisms play an important part in the etiology of diabetes, and that a certain number of persons suffering from pruritis, eczema, furuncles and gangrenous lesions will be found to have the disease.

When albumin is associated with the excretion of glucose the prognosis will be considered

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of grave import; it points to a sclerotic change. The prognosis is unfavorable also in one suffering from diabetes in early life, as the disease will likely terminate fatally within a short time.

In the loss of the reflex knee jerks there is associated with the glycosuria a neurotic element which is always of grave import. Cramps in the legs are unfavorable symptoms.

When diabetes is associated with pregnancy great danger is to be apprehended for the fetus. Hepatic complications are also unfavorable.

Some writers regard diabetes as contagious, basing this opinion on cases of conjugal diabetes, as well as that persons having daily intercourse with these sufferers often contract the disease.

GOUT.

Some writers claim that gout results from an increased production of uric acid, while others believe it to follow a faulty elimination of uric acid or the urates. We are not, however, called upon in a work of the scope of this one to discuss the views or theories of the etiology of gout, but rather to deal with such characteristics as will help in the diagnosis and

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treatment of such complaints as are classed as gouty, or due to a uric acid diathesis. Osler classifies gout as acute, chronic and irregular. In the acute form there are twinges of pain in the smaller joints of the hands and feet, acid urine, scanty and high colored, which deposits urates upon standing. Ganol asserts that there may be transient albuminuria and occasionally traces of glucose.

Preceding an attack of gout there will be a diminished amount of urates or uric acid found in the urine. Occasionally there will be sore throat, or symptoms of asthma, swelling of the joints, fever, extreme sensitiveness, great pain, dyspepsia, and irregular heart action lasting usually from five to eight days. After a time these attacks, if continued, will pass into the chronic form of the disease, other joints will become affected, deposits of urates will take place in the articulations and cartilages, thus, by degrees proceeding to the conditions so characteristic of chronic gout.

The irregular form is generally termed the gouty diathesis, and is found usually in generous livers. There are many *irregular* features

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or symptoms, such as skin eruptions, particularly eczema. There will be gastro-intestinal disturbances with constipation and inactive liver; disturbances of the circulation, progressing occasionally to sclerosis, neurasthenia, epilepsy, heart and kidney changes with albuminuria and dropsy; finally nephritis and pericarditis may follow.

Urinary disturbances are the rule. There is an increase of uric acid which deposits upon the urine cooling. Sometimes, as elsewhere stated, a glycosuria follows which may in rare instances proceed to true diabetes, oxaluria, vesical and renal calculi; albumin and tube casts in the urine; urethritis; pulmonary disorders, such as bronchitis and asthma; affections of the eye, as, for instance, glaucoma, etc.

Treatment for the several forms of gout will be largely dietetic and hygienic. Abstemiousness must be insisted upon; saccharin, starchy or fatty foods should be restricted; bowels kept freely open—in fact, the treatment should begin with a free use of an alkaline or saline purgative. Patients with elevation

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of temperature should be compelled to remain quietly in bed in order to secure the greatest amount of rest in the inflamed joints. A diet of milk is desirable.

It has been found that the lithium salts of uric acid are far more soluble than the combination with other elements, and the lithium salts and waters are, therefore, extensively employed in gouty affections. Lysidin and piperazin form, also, freely soluble salts with uric acid, and have proven of great value in this and similar troubles.

For local application to the inflamed joint or joints various remedies are employed, such as oil of wintergreen; 5 to 10 per cent alcoholic solution of menthol, guaiacol in ointment, or 10 per cent solution in glycerine, etc. After local applications the parts should be covered with cotton and bandaged.

Dry, hot air of a temperature from 250 to 400 deg. F. has lately received favorable mention.

Never bleed a gouty patient or apply cold to the inflamed parts, but cover with cotton and oil silk. The application of cold is most dan-

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gerous. Very hot air applied to the painful joints is recommended.

Alcoholics should be sparingly indulged in; if used at all should be in the form of spirituous liquors, preferably whisky. Beer and wine should be at all times avoided. Vichy water taken with milk is useful and agreeable to the patient. When there is an absence of acute symptoms patients should be urged to take plenty of outdoor exercise. Light woolens should be worn, and frequent hot baths followed by friction should be indulged in. Luff and others declare that sodium salicylate is contraindicated in gout because of its tendency to favor an increased production of uric acid.

In acute or chronic forms of gout, colchicum will be found the most useful remedy; its action being that of a chologogue, it prevents the glycocin from passing untransformed into the blood and so acts as a preventive to the formation of uric acid. Great caution should be exercised in giving colchicum to asthenic cases, because of its depressing action. Alkalies other than the salts of sodium are useful by their influence upon metabolism and the im-

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provement of the general nutrition, as well as the gastric and hepatic functions.

Sir Wm. Roberts, as well as Luff, declares, after repeated experimental studies, that the salts of sodium reduce the solubility of the biurates. The last mentioned author declares that plain water dissolves 1.1 per 1000 of the sodium biurates. Water should, therefore, be freely partaken of by those having a gouty diathesis. Guaiacum is recommended by Garrod in those cases where gouty pains are relieved by warmth, its action being a stimulant to the liver metabolism. He claims that it acts also as a powerful prophylactic.

CYSTITIS.

Cystitis is a far more frequent disease than formerly supposed. By the invaluable aid of the microscope we are now, however, able to diagnose cystitis in its early stages, and while still curable. Have the patient urinate into two or three separate glasses or receptacles, if possible, or secure the urine by a recently sterilized catheter under aseptic precautions. If the last portion of urine obtained contains nu-

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merous bacteria, a positive diagnosis of cystitis can be made; even though the reaction of the urine is neutral or faintly acid. Naturally, the condition is of a more chronic character when the urine is alkaline, perhaps ammoniacal, lumpy or stringy.

Serious complications, such as pyonephrosis, etc., may follow a recent and apparently mild cystitis, according to the virulence of the causative micro-organisms. With the exception of comparatively few traumatic cases, cystitis is *always* infective, i. e., a bacterial disease. It accompanies many of the infective diseases, and is a usual complication of lithiasis, gonorrhea, prostatic hypertrophy, stricture, etc., and invariably follows, and is the frequent cause of death in spinal and other diseases, where retention and consequent catheterization causes trauma and infection from careless sterilization of catheters.

Carelessness in catheterization may, in fact, be put down as one of the most frequent and least excusable causes of some of the worst cases of cystitis met with; and enough em-

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phasis cannot be expressed as a warning against such malpractice.

In chronic cystitis the mucous glands are so overstimulated that the urine is more often stringy, especially as the urea, through bacterial agencies, has become converted into ammonium carbonate, which last further irritates the bladder-walls.

Following this, is hyperplasia and formation of granulation tissue, which condition can be improved only by an open operation, curettage or similar treatment. In some cases the pathogenic conditions extend through the ureters into the pelvis of the kidney, if not into the renal tissues themselves, causing pyonephrosis or perinephrosis.

The symptoms of cystitis are: Great frequency of micturition, with the passage of only a small amount, or even but a few drops of urine, tenesmus and burning, pain over pubes or in perineum and rectum, radiating into the thighs and loins, or over the sacrum. There is more or less elevation of temperature, and sometimes even a chill. The urine contains a

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quantity of albumin, bacteria and pus, as well as blood.

The treatment of acute cystitis must first be directed to an effort to remove the cause. If from irritating drugs, this is easily accomplished, as also if from improper catheterization. In all acute cases the next step must be to reduce the irritation caused from acid, concentrated urine, by administering excessive amount of water—plain, or as the alkaline mineral vichy water, a weak lemonade (which through digestion renders urine alkaline), or other demulcent drinks, such as milk.

Urotropin, grs. 7 in hot water, 2 to 3 times a day, salol, sodium benzoate or boric acid, grs. 5 every three hours, are, perhaps, the most successful remedies. If the pain is severe, 15 minims of the tincture of hyoscyamus may be given three times a day, or a suppository containing one grain of opium. Keep the bowels loose with a saline cathartic. A hot sitz-bath may often relieve the patient. When the acute symptoms have subsided, it may be advisable to wash out the bladder or treat a posterior urethrites with deep injections.

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In chronic cystitis similar procedures are used, but it is here usually necessary to draw off residual urine a couple of times a day or more with a soft rubber catheter under due antiseptic precautions, after which the bladder is irrigated with solutions of boric acid, bichloride (1:5000), permanganate (1:1000, or less).

If a chronic cystitis is of very long duration and nothing else will help, perineal cystotomy with drainage, or superpuberic operation with or without curettage and perineal drainage may be necessary.

OTHER CONDITIONS.

Suppression (anuria) *of urine* may result from acute nephritis, stone in the kidney or from irritant poisons, such as turpentine, phosphorus, lead, as well as from shock and hysteria. Cupping, hot applications and the use of pilocarpin hypodermically are appropriate means of treatment, as are the hypodermic injections of strychnia, 1-60 gr.; digitalin, 1-60 gr., or nitroglycerin, 1-50 to 1-100 gr.

Hematuria (hemorrhage) may follow acute inflammatory condition of the kidneys, ulcer

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of, or stone in the bladder or kidneys, gonorrhea and the taking of poisons such as carbolic acid, turpentine, cantharades, etc. The urine will be colored in intensity according to the amount of blood present. When the blood proceeds from the kidneys it will be thoroughly mixed with the urine; if from the bladder or urethra it will be noticed at the end of micturition. Treatment should consist of rest, opium, gallic acid and cold applications to the loins.

Pyruria (pus) *in the urine* indicates abscess in the kidney, pyelitis, cystitis, gonorrhea or leucorrhea. In abscess of the kidney the pus will be discharged at once following rupture of the abscess walls, and will have been preceded by pain in the kidney with pyrexia. In pyelitis there will be lumbar pain, vesical irritation, and flexion of the thighs. In cystitis the urine will be alkaline, ropy and accompanied with mucus; pus and urine will be discharged with the last portion of urine, while in gonorrhea it will precede the discharge of urine. In leucorrhea the quantity of pus will be small, and accompanied with flat epithelium.

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Treatment for pyruria will be suggested by the conditions which cause it.

Retention of the urine is produced by mechanical obstructions, as paralysis, spasm, inflammation, etc. If from mechanical obstructions, such as stone, enlarged prostate, stricture, etc., the treatment will consist of removal of the obstruction; if from paralysis or spasm by the use of the catheter, or, in the case of spasm of the neck of the bladder by anodynes. If urgent, chloroform may be necessary. Retention from inflammation will be best treated by the use of warm enemas, diluents, warm bath and mild laxative.

Polyuric symptoms of certain nervous affections are best treated by the administration of tinct. of valerian and fluid ext. ergot of each 15 drops, three to five times a day. The polyuria of diabetes insipidus by an exclusive milk diet and syr. hypophos. co. U. S. P. in teaspoonful doses alone or with codeia.

Hyperacidity is corrected by

a. Prophylactic; mixed diet, settled habits, plenty of sleep, large draughts of plain and carbonated water.

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b. In diabetes by the exclusion of proteids and the ingestion of sufficient amounts of carbohydrates.

c. Medicinal; citrate of potassa, 5-30 grains in half an ounce of peppermint water three or four times a day.

Renal congestion is due to an increased amount of blood to the kidneys, and is diagnosed by pain along the course of the ureters into the genitals and bladder; urine is highly colored and scanty, with increased specific gravity, and may contain albumin, casts, as well as epithelium, also urates. If not relieved, dropsy of the lower extremities will follow. The treatment will aim to remove the irritation; rest in the recumbent position, demulcent drinks, hot poultices over lumbar region and tonics.

Incontinence may result from numerous causes, and is best treated with ergot and tinct. chlorid iron, together with tonics.

Acid and alkaline urine must be treated by remedies directed to the changing of the character of the urine reaction.

Irritable bladder will yield best to antispas-

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modics such as opium, hyoscyamus, or belladonna.

Fermentation of the urine will require a germicide such as salol, benzosol, naphthalin, etc. This will be appropriate treatment also for bacteria and fungi in the urine.

Gonorrhea and Prostatis, as well as Vesical and Renal calculi, will require treatment as outlined in works on surgery.

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FAVORITE PRESCRIPTIONS.

FOR UREMIA.

R.—Ext. pilocarpi alc.,
Ext. scillae,
Resin jalapae,
Resin scammonii.....aa grs. 15
M. Ft. pil. No. 20. Sig.: Four or five pills daily during as many. days.

FOR ALKALINE URINE.

R.—Acidii boraci .....dr. 2½
Ext. uva ursa, fl.,
Ext. hyoscyam, fl.,
Ext. lupulin fl.....aa dr. 4
Syr. zingerberis .....oz. 2
Aqua q. s. ad.....oz. 6
M. Sig.: Two teaspoonfuls in water after meals.

FOR IRRITABLE BLADDER.

R.—Salol,
Tinct. hyoscyami .....aa dr. 2
Infus. buchu q. s. ad.....oz. 6
M. Sig.: Tablespoonful three times a day.
—Fothergill.

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FOR ACID URINE AND FREQUENT URINATION.

R.—Lithii citratis .....oz. 2
Tinct. opii camph.....oz. 1
Infus. lupulini q. s. ad.....oz. 16
M. Sig.: Tablespoonful in water after meals.

DIURETIC FOR CHILDREN.

R.—Potassii acetat,
Potassii nitrat .....aa gr. 15
Oxymel scillae
Syr. sarsaparill. co .....aa dr. 2½
Infus. juniper berries.....oz. ½-3½
M. Sig.: To be taken during the day.

FOR CYSTITIS—CHRONIC.

R.—Ext. uva ursa.....dr. 6
Tinct hyoscyami .....dr. ½
Tinct. opii camph.....oz. 1½
Liq. potassae .....dr. 2
Tinct. lupulini .....dr. 3
Syrup simp .....oz. ½
Aq. menth. pip. q. s. ad.....oz. 6
M. Sig.: Dessertspoonful twice daily.

FOR NOCTURNAL INCONTINENCE OF URINE.

R.—Antipyrin .....gr. 8
Sig.: Give such a powder at bedtime and continue until habit is corrected.

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FOR GOUT.

R.—Tinct. colchici sem.....gtt. 15
Magnesia carb. .....gr. 6
Magnesia sulph. .....dr. ½
Aq. menth. pip. q. s. ad.....oz. 1
M. Sig.: Give in one draught and repeat according to conditions.

ANOTHER—GARROD'S GOUT PILLS.

R.—Ext. colchici acet,
Ext. rhei,
Ext. aloes soc.....aa gr. 12
Ext. belladonna .....gr. 2
M. Ft. pil. No. 10. Sig.: One pill at bed-time twice a week.

FOR THREATENED UREMIA.

R.—Pilocarpin .....gr. ½-1
Acid hydrochlor. dil.....dr. 2
Aqua dest .....oz. 2
M. Sig.: Teaspoonful every three hours.

FOR NEPHRITIS.

R.—Potassii bitart..... 30.0
Potassii sulph..... 15.0
Scilli pulv 8.0
Antimon et potassii tart..... 0.06

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M. Sig.: Teaspoonful in tumbler of water every four hours until active purgation and free diuresis is obtained.

FOR ACUTE CYSTITIS.

R.—Ext. buchu fl.....oz. 2
Potassii cit.....dr. 3
Spir. ether nit.....dr. 4
Syrupi q. s. ad.....oz. 8
M. Sig.: Dessertspoonful every four hours.

R.—Ext. hyoscyami.....gr. 9
Ext. cannab. ind.....gr. 9
Sacch. alb.....gr. 75
M. Ft. pulv. No. 12. Sig.: One three times day.—Ultzmann

R.—Canada Balsam.....gr. 300
Calc. magnesia.....gr. 30
Soap,
Benzoin, aa q. s. ft. pil. No. 100.
M. Sig.: At first four times a day, afterwards five times a day.

FOR PAIN IN CYSTITIS.

R.—Ext. hyoscyami.....gr. ½
Camph. mono.....gr. 2
Morph. sulph.....gr. ½
Ol. theobromat q. s. suppository No. 1.

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FOR CHRONIC OR IRREGULAR FORM OF GOUT.

R.—Sodii bicarb.....gr. 45
Acid benzoic.....gr. 40
Sodii phosph.....gr. 80
Aq. bullien.....oz. 1½
Solve et ad
Aq. cinnamon.....oz. 3
M. Sig.: Dessertspoonful three times a day.

FOR RELIEF OF PAIN AND VESICAL SPASM.

R.—Ext. opii.....gr. 6
Ext. hyoscyami.....gr. 3
Olei theobromat. q. s. ft. suppository No. 6. Sig.: Introduce one into the rectum and repeat in two hours if required

FOR PROSTATITIS.

R.—Ichthyol.....gr. 5-12
Ext. belladonna.....gr. ¼
Cocoa butter q. s. for suppositories No. 1. Sig.: Two or three such suppositories daily.

FOR IRRIGATION OF THE BLADDER.

R.—Acidi borici.....dr. 1
Sodii borat.....dr. ½
Sodii chloridi.....gr. 15
Aqua.....pint 2
M. Warm to 100 deg. F. and use through double canula catheter.

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DIABETES INSIPIDUS.

R.—Opii pulv.....gr. 4
Acidi gallici.....oz. 2
Mix into 12 powders and give one powder three or four times a day.

FOTHERGILL'S DIURETIC PILLS.

R.—Pulv. fol. digital.,
Pulv. scillae,
Hydrarg. chlor. mit....aa grs. 100.
M. ft. pil. No. C, one to two pills a dose.

BASHAM'S MIXTURE.

R.—Tinct. ferri. chloridi.....	parts	10
Acidi acetic dil.....	"	15
Sol. ammon. acetat.....	"	100
Elix. aromat.....	"	50
Glycerini	"	60
Aqua ad	"	500

M. Dose 1 to 4 teaspoonfuls.

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FORMULAE OF SOLUTIONS.

PAVY'S SOLUTION.

Cupric sulphate.....gr. 320
Neutral potassic tartrate.....gr. 640
Caustic potash.....gr. 1,280
Distilled water.....fluid ounces 20

Note.—One dram is decolorized by one-third grain of glucose.

FEHLING'S SOLUTION.

a. Copper sulphate.....gm. 34.65
Distilled water to make.....cc. 500
b. Potassium sodium tartrate..gm. 173
Potassium hydrate.....gm. 125
Distilled water to make.....cc. 500

For use mix equal parts of the two solutions when required.

Note.—One cubic cent. of the combined solution is decolorized by 5 millograms of glucose.

ESBACH'S FLUID.

Picric acid.....gm. 2.5
Citric acid.....gm. 5.0
Distilled water to make.....cc. 250

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HAINES' SOLUTION.

Cupri sulphat, pure.....gr. 30
Distilled water .....oz. ½
Glycerin .....oz. ½
Liq. potassa.....oz. 5

DOREMUS' SOLUTION.

Caustic soda.....(oz. 6) gm. 100
Distilled water.....(oz. 16) c.c. 250
Add when dissolved and cool
Bromine .....c.c. 2.5

MAGNESIUM FLUID.

Magnesium sulphate, pure.....part 1
Ammonium chloride, pure.....parts 2
Distilled water .....parts 8
Liquid ammonia, pure.....part 1

LOEFFLER'S METHYLENE BLUE SOLUTION.

(for staining bacteria.)

Concentrated alcoholic solution of
Methylene blue.....c.c. 30
Caustic potash solution 1-10,000.
.....c.c. 100
Mix.

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ZIEHL'S CARBOL-FUCHSIN SOLUTION.

(for staining bacteria.)

Fuchsini .....gm. 1.0
Alcohol .....c.c. 10.
Distilled water.....c.c. 100.
Acid carbolic cryst.....gm. 5.0
Mix and make solution.

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REAGENTS REQUIRED.

Nitric Acid c. p.
Nitric Acid com.
Hydrochloric Acid c. p.
Sulphuric Acid c. p.
Acetic Acid c. p.
Solution Caustic Potassa (1 part to 2 parts distilled water.)
Solution Caustic Soda (1 part to 2 parts distilled water.)
Solution Sugar Lead (1 part to 4 parts distilled water.)
Solution Copper Sulphate (15 grs. to 1 oz. distilled water.)
Solution Magnesium Sulphate.
Solution Barium Chlorid.
Pavy's Copper Solution.
Fehling's Copper Solution.
Liquor Ammonia.
Distilled Water.
Alcohol, 95 per cent.
Tinct. Guaiac.
Turpentin (oxidized).
Bismuth Subnitrate.

The above reagents, with the exception of the last 5, are offered by Messrs. Eimer & Amend, New York. Acids in 2-oz. glass-stoppered bottles, and the Solutions in 4-oz. rubber-stoppered bottles, for $3.50 net.

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APPARATUS.

1 doz. Test Tubes.
1 Test Tube Rack.
½ doz. Test Tubes on foot.
¼ doz. Settling or Wine Glasses.
1-3 doz. (Nest) Beaker Glasses.
1 Graduate, 4 ozs.
1-3 doz. Porcelain Capsules, asst. sizes.
1-6 doz. Glass Funnels and Support.
1-6 doz. Watch Glasses.
1 Glass Stirring Rod.
1 Pipette, 10 c. cm.
1 Burette with Glass Stopcock and Support.
1 Cylinder Graduated 500 c. cm.
1 Spirit Lamp.
1 Water Bath.
Filter Paper, White.
Litmus Paper, Red and Blue.
Platinum Foil.
1 Urinometer, Squibb.
1 Ureaometer, Doremus.
1 Albuminometer, Esbach.
1 Saccharometer, Einhorn.
1 Centrifuge.
1 Microscope with Slides, &c.

The above apparatus, exclusive of Centrifuge and Microscope, are offered by Messrs. Eimer & Amend, New York City, for $12.80 net, the Centrifuge for $13.00.

The Spencer microscope 4 F, consisting of a stand, as illustrated on page 75, with two eye-pieces, objectives 2-inch, 2-3-inch, and 1-6-inch, with triple nose-piece, and one-half gross slides, ground edges, complete in case, for $56.35.

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METRIC WEIGHTS AND MEASURES.

Weights.

1 milligram	0.001 grams	0.015 grains Troy.
1 centigram	0.01 "	0.154 " "
1 decigram	0.1 "	1.543 " "
1 gram		15.432 " "
1 decagram	10. "	154.324 " "
1 hectogram	100. "	0.268 pounds "
1 kilogram	1000. "	2.679 " "

Measures.

1 millimeter	0.001 meter	0.0394 inch.
1 centimeter	0.01 "	0.3937 "
1 decimeter	0.1 "	3.9371 inches.
1 meter		39.3708 "
1 decameter	10 "	32.8089 feet.
1 hectometer	100 "	328.089 "
1 kilometer	1000 "	0.6214 mile.
1 yard or 36 inches		0.9144 meter.
1 inch		25.4 millimeters.

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FOR CONVERTING MINIMS INTO CUBIC CENTIMETERS.

Minims.	Troy.	Cubic Centimeter.	Minims.	Troy.	Cubic Centimeter.
480	1 oz.	30.00	40		2.50
360	6 dr.	22.50	30		1.90
300	5 dr.	18.75	20		1.25
240	4 dr.	15.00	15		1.00
180	3 dr.	11.25	10		.60
160		10.00	8		.50
120	2 dr.	7.50	7		.42
100		6.25	6		.36
90		5.60	5		.30
80		5.00	4		.24
60		3.12	3		.18
50		3.75	2		.12
			1		.06

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FOR CONVERTING GRAINS INTO GRAMS.

Grains.	Troy.	Grams.	Grains.	Troy.	Grams.
480	1 oz.	32.00	3		0.20
420		27.20	2		0.13
360		23.30	1		0.065
300		19.40	1/2		0.032
240	½ oz.	16.00	1/3		0.02
180		11.65	1/4		0.016
120		7.80	1/6		0.01
60	1 dr.	4.00	1/8		0.008
50		3.20	1/10		0.006
40		2.60	1/12		0.005
30	½ dr.	1.95	1/16		0.004
25		1.57	1/20		0.003
20		1.30	1/30		0.002
15		1.00	1/40		0.0016
10		0.65	1/60		0.0011
8		0.52	1/100		0.0006
6		0.39	1/120		0.0005
5		0.32	1/200		0.00033
4		0.26	1/400		0.00016

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COMPARATIVE THERMOMETER SCALES.

Reaumur.	Centigrade.	Fahrenheit.	
80°	100°	212°	Water Boils.
76	95	203	
72	90	194	
68	85	185	
62.1	78.9	174	
60	75	167	Alcohol Boils.
56	70	158	
52	65	149	
48	60	140	
44	55	131	
42.2	52.8	127	
40	50	122	
36	45	113	
33.8	42.2	108	
32	40	104	
29.3	36.7	98	Blood Heat.
28	35	95	
25.8	32.2	90	
24	30	86	
21.3	26.7	80	
20	25	77	
16	20	68	
12.4	15.5	60	Temperate.
10.2	12.8	55	
8	10	50	
5.8	7.2	45	
4	5	41	
1.3	1.7	35	

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0	0	32	Water Freezes.
— 0.9	— 1.1	30	
— 4	— 5	23	
— 5.3	— 6.7	20	
— 8	—10	14	
— 9.8	—12.2	10	
—12	—15	5	
—14.2	—17.8	0	Zero Fahr.
—16	—20	— 4	
—20	—25	—13	
—24	—30	—22	
—28	—35	—31	
—32	—40	—40	

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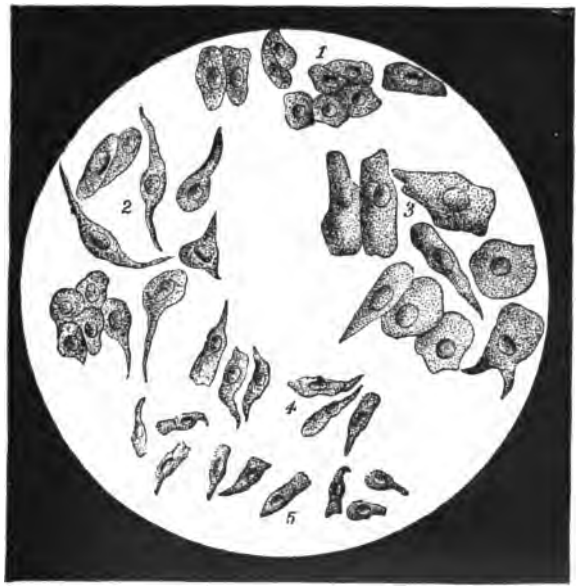

PLATE I.

1. Epithelium from the straight tubes of the kidney. The cylindrical cells come from the part nearest the papilla, the others from the higher tubules (medullary rays). After long standing these become spherical. —2. Epithelium from the kidney, pelvis, and ureters.—3. Epithelium of the bladder.—4. Epithelium of the prostate.—5. Epithelium of Cowper's glands.

Plates. I. to XVI. inclusive are after Hoffman & Ultzmann.

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PLATE II.

1. Epithelium of the male urethra.—2. Epithelium of the female urethra.—3. Epithelium of Littré's glands. Plate I., 4 and 5, and Plate II., 1 and 2, all represent the so-called cylindrical epithelium. —4. Vaginal epithelium.

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PLATE III.

Primary forms of uric-acid crystals, the so-called whetstone crystals. These are always colored as a native precipitate, but are rendered colorless by solution and reprecipitation.

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PLATE IV.

Uric acid: the sediment as found in native urine; rosettes, and lamellated crystals; also the sharp crystals as found in pyelitis calculosa.

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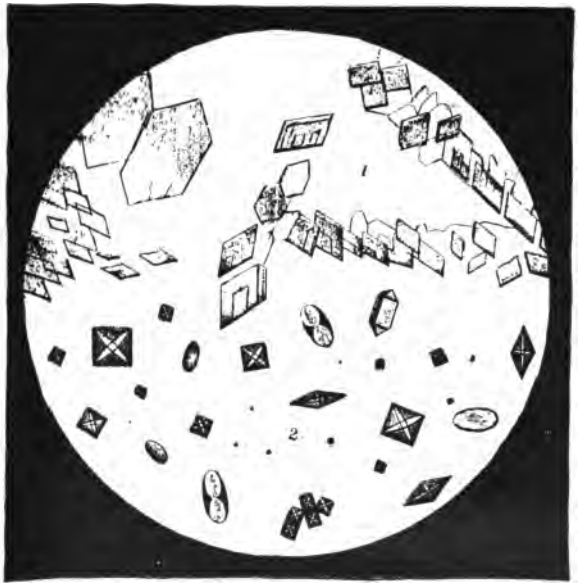

PLATE V.

1. Nitrate of urea, as seen when a drop of HNO_3 is allowed to flow under the cover-glass. Rhombic and hexagonal plates.—2. Oxalate of calcium, as the native sediment of an acid urine. Tetragonal octahedrons and the so-called hour-glass forms.

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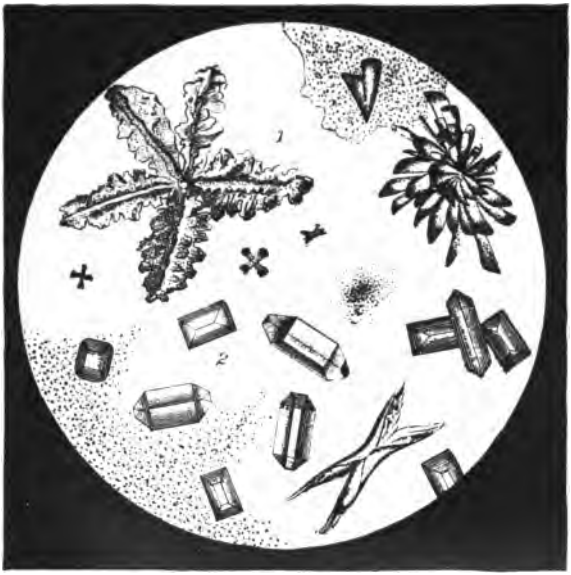

PLATE VI.

Triple phosphate $(NH_4)MgPO_4+6H_2O$. The common coffin-lid crystals at the bottom of the figure, and above the fern-leaved crystals of the same, as seen when quickly precipitated by addition of ammonia. The crystals in the upper righthand corner are crystals of phosphate of calcium, of the formula $PO_4HCa+2H_2O$, from a weakly acid urine, with a tendency to become alkaline. The triple phosphate is found in alkaline urine.

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PLATE VII.

Leucine and tyrosine: sediment from acute yellow atrophy of the liver; sheaves of tyrosine needles, and the drop-like forms of leucine, with small double spheres of ammonium urate.

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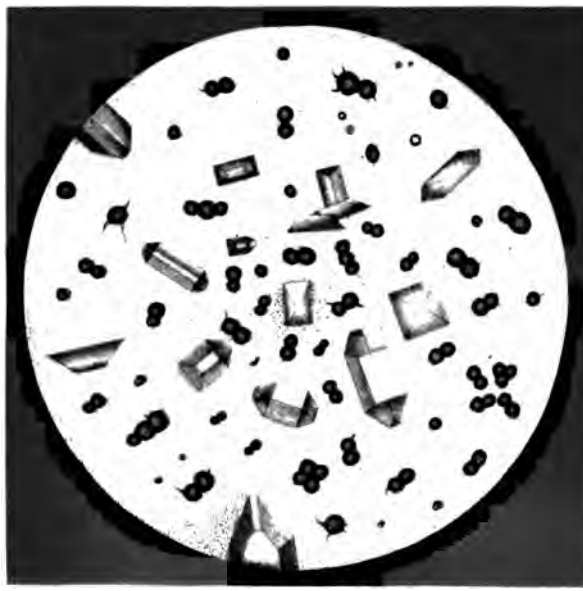

PLATE VIII.

The sediment of alkaline fermentation: the coffin-lid triple phosphates; the brown double spheres of ammonium urate, and the amorphous tribasic calcium phosphates mixed with bacteria.

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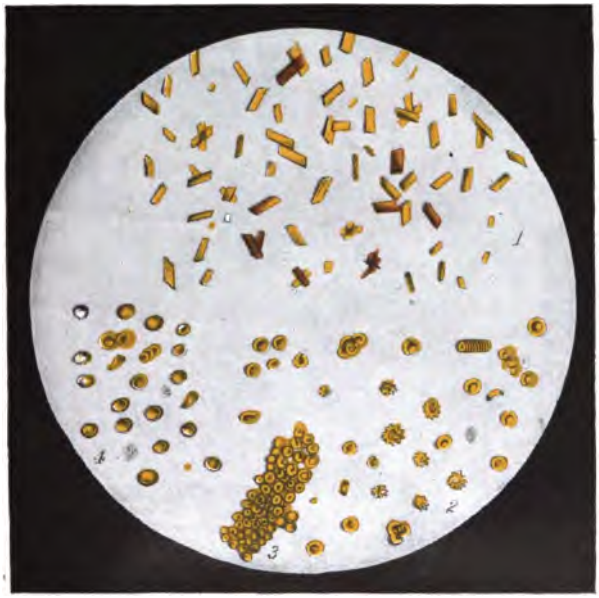

PLATE IX.

1. Hæmin, or chloride of hæmatin, obtained by adding a grain of salt to the residue of a drop of urine evaporated on an object-glass, and then allowing a drop of acetic acid to flow under the cover.—2. Blood-corpuscles of various forms, and a blood-cylinder.

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PLATE X.

Urate of sodium, the amorphous precipitate (sedimentum lateritium); also, the crystals of calcium oxalate and uric acid, together with fermentation fungi, which make up the sediment of a febrile urine.

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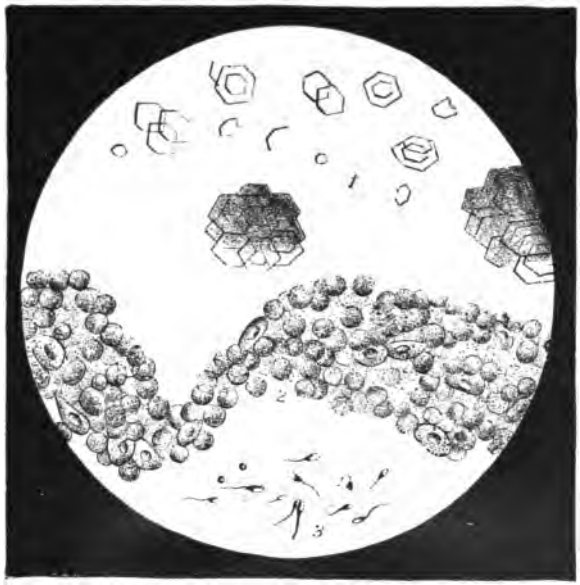

PLATE XI.

1. Cystine: the powder of a cystine stone dissolved in ammonia, and evaporated on an object-glass; hexagonal plates, colorless.—2. Gonorrhœal thread, the catarrhal secretion from the accessory glands of the urethra.—3. Spermatozoa.

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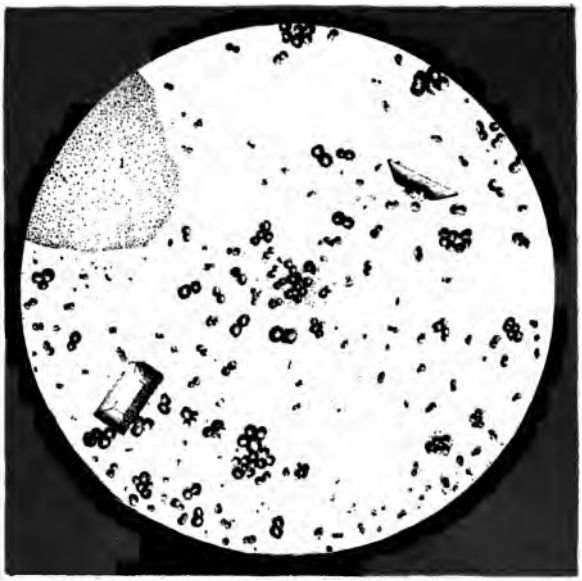

PLATE XII.

1. Calcium carbonate, seldom found.—2. Sediment of an alkaline urine, spheres, dumb-bells, and granular precipitate, found usually in connection with the earthy phosphates.

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PLATE XIII.

1. The massive fibrin cylinder.—2. The granular cylinders.—3. The hyaline cylinder.—4. The waxy cylinders.—5. Epithelial casts and cylinders.—6. The uric-acid cylinders.

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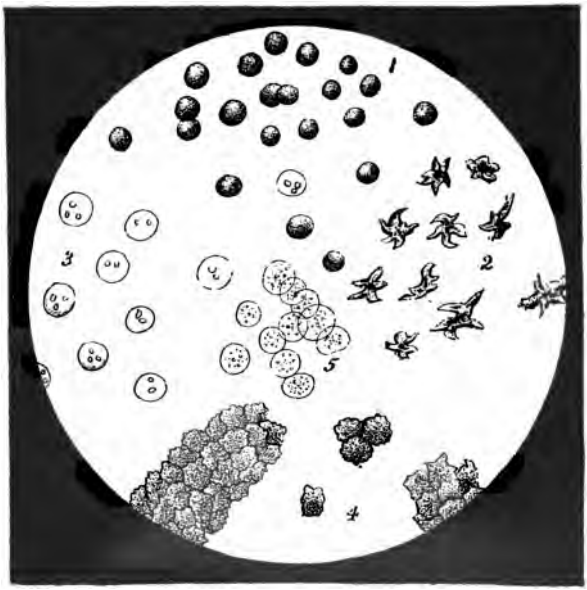

PLATE XIV.

1. The ordinary pus-corpuscles.—2. Those with prolongations showing amœboid movements.—3. Corpuscles with their nuclei rendered distinct by adding acetic acid.—4. Corpuscles as altered by chronic pyelitis.—5. Corpuscles swollen by the action of carbonate of ammonium.

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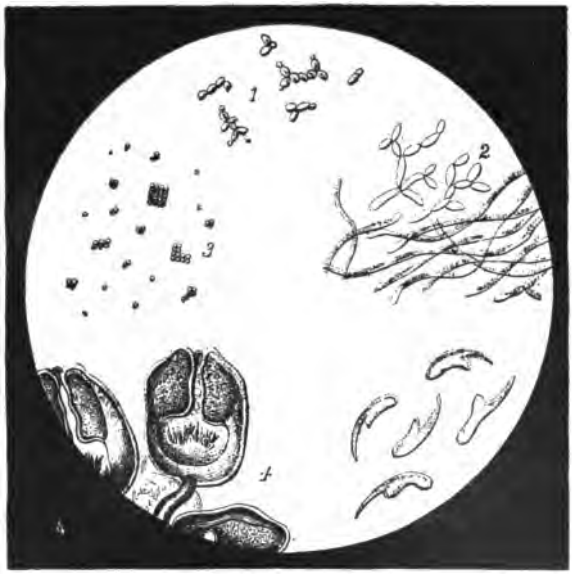

PLATE XV.

1. Yeast fungi.—2. Penicillum glaucum.—3. Sarcina.—4. Cyst of the echinococcus, with detached hooks.

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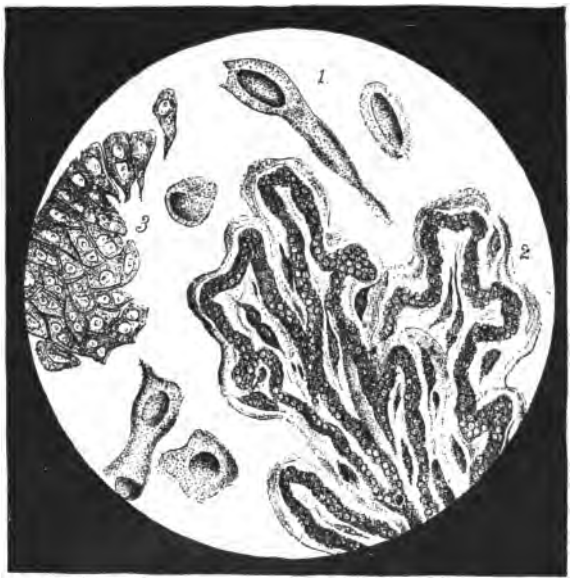

PLATE XVI.

1. Cancer elements, as seen in the sediment of medullary epithelial cancer of the bladder.—2. A fragment of cancerous villous tissue of seldom occurrence.—3. Epithelial cells stripped from surface of villous cancer.

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